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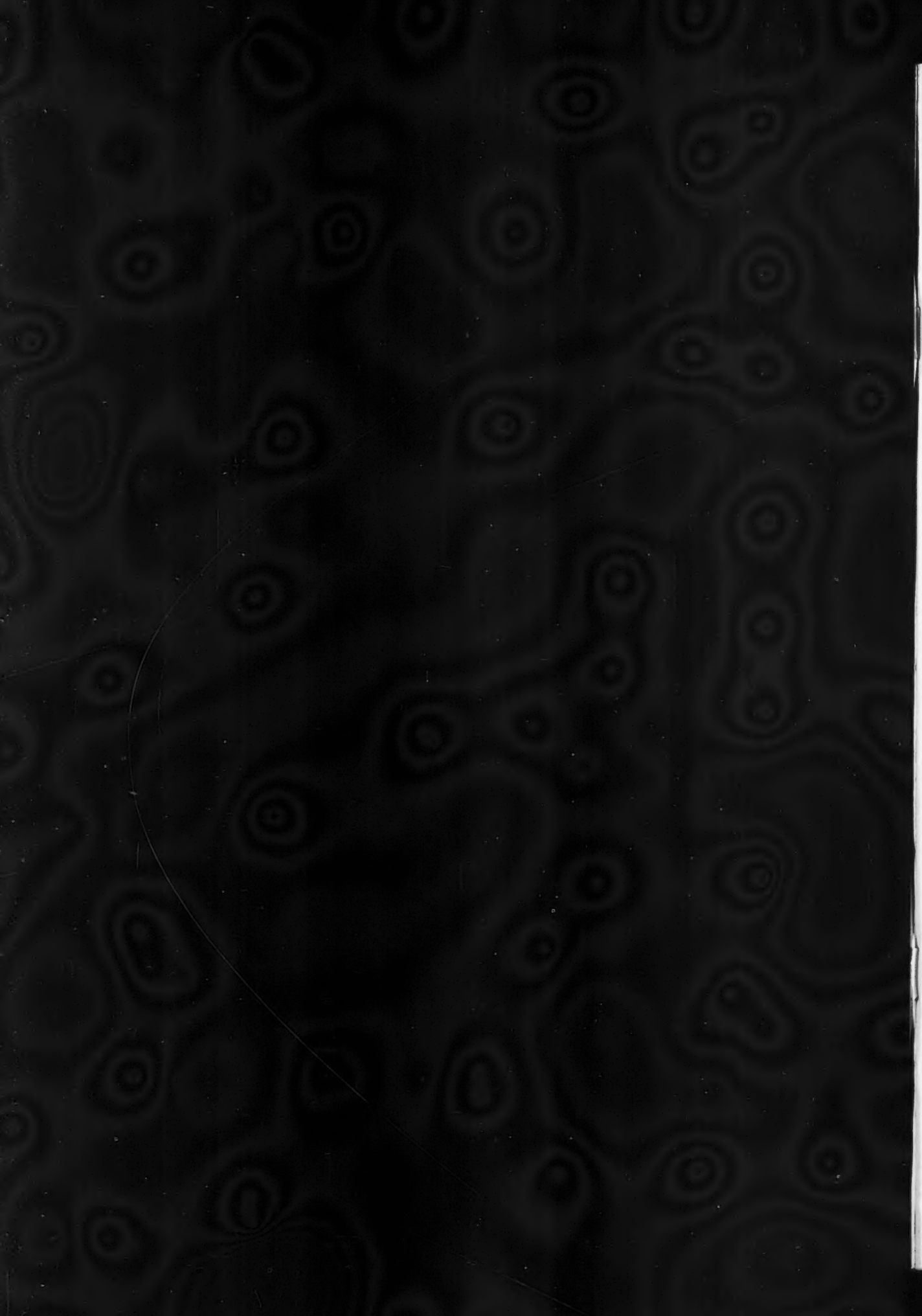

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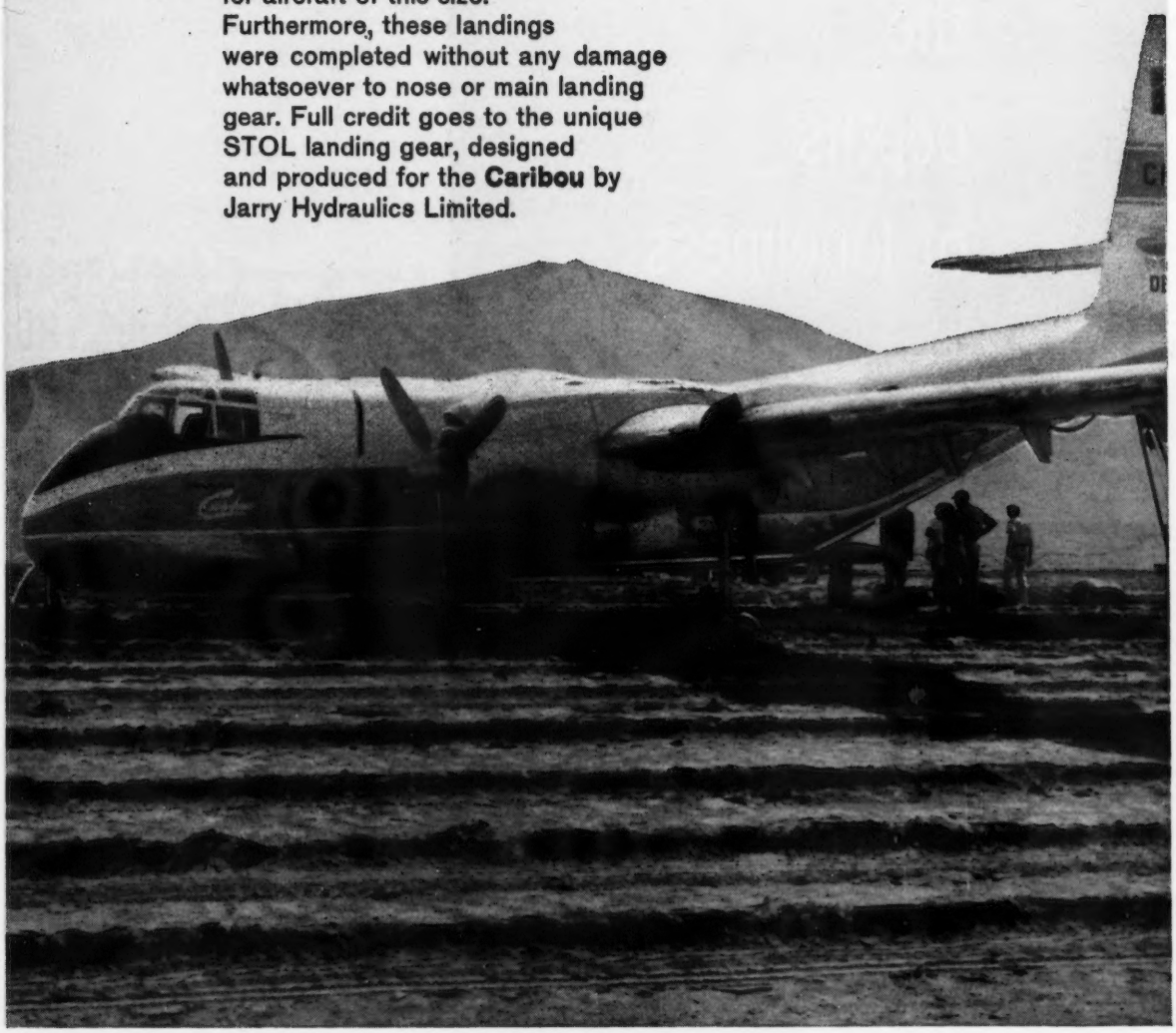

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THE PRESIDENT 1960-61

David Boyd

EDITORIAL

THE PRESIDENT'S MESSAGE

EACH of the Branches of the Institute is about to launch its programme for the 1960-61 season. This means that the several Branch Executives have been hard at work arranging programmes and attending to the mass of detail essential to the proper functioning of a Branch.

Parallel with the labours of the Branches the Council, through the Executive Committee and the Staff at Headquarters, has been equally diligent. The results of these labours should be apparent early in the coming season.

Council has been seriously concerned for the past two seasons with financial problems. Every effort at economy was instituted and now a vigorous campaign to restore our finances is underway. Council has decided that we have left behind the period of uncertainty as to the future of the industry and that a vigorous move forward is essential. The Institute, in common with all other organizations, cannot remain static but must expand or perish.

This brings me to the most important factor in the situation – the individual member. The structure of our Institute – the whole hierarchical edifice of Branch Executives, Council and Headquarters – exists only as a mechanism to serve the membership. You can be assured that the directing groups are doing their utmost to discharge their responsibilities and the only unknown factor in the total sum is *you* – the individual member!

I urge all members of all grades to take a more active part in the various meetings, to furnish constructive criticism and to induce others to join the Institute. With every member an active member we can anticipate a successful year. It will be my pleasure, as your President, to visit each Branch during the season to participate in the meetings, to assess at first hand the progress achieved and to greet old friends.

DAVID BOYD
President 1960-61

THE INDUSTRY WE SERVE†

by F. T. Wood*

Air Industries and Transport Association of Canada

Mr. F. T. Wood

It is indeed both a pleasure and a privilege to have been asked, in my capacity as President of the Air Industries and Transport Association, to address you tonight, not only for personal reasons but also because of the intimate relationship, directly or indirectly, that exists between your fraternity of aeronautical scientists, engineers and technical personnel and the industry that the AITA represents. As you know, there are two sides to AITA – the operators and the constructors, both of which depend in large measure on your skills and enthusiasm, either singly or in teams, for their existence.

THE INDUSTRY

As you have been reminded on many occasions recently, aviation in Canada commenced over fifty years ago, with the construction and flight of the Silver Dart in 1909. On the manufacturing side of the industry development was fairly rapid, due to the First World War – in the period 1914-1918, nearly 3,000 aircraft were built in Canada for use in the training of pilots and observers for the RFC. After the Armistice, the demand for aircraft from Canadian industry ceased and the industry virtually vanished. However, aviation as a whole did not die, for during the period up to 1923 considerable flying was done in Canada using war surplus machines, which had to be maintained and overhauled. Commencing in 1923, several aircraft companies were formed and by 1929 twelve of these had been established in Canada, mostly as subsidiaries of UK or US firms, including some which are still in existence, such as De Havilland, Pratt & Whitney, Bristol and Fleet. These companies and others were involved in the design and manufacture of various types of transport, bush and training aircraft, maintenance and overhaul of aircraft, engines, instruments, accessories etc, and managed to struggle through the depression years, much to their own amazement as well as that of the country at large.

Then came World War II and the explosive expansion which had to take place to meet the requirements can be best illustrated by a few simple statistics: in 1939, the industry employed 3,600 personnel; this increased to over 44,000 by 1945. During this period, several thousand aircraft, including Tiger Moths, Ansons, Hurricanes, Cansos, Hell Divers, Harvards, Mosquitoes and Lancasters, were built in Canada. After the cessation of hostilities came the inevitable contraction, so that in 1946 only 11,000 people were employed. As international tension increased through the Korean War, and civil aviation activities expanded, the industry once more experienced increased activity so that by 1952 and up to the present time some 30,000 to 40,000 people have been directly employed in the industry.

From 1947 to 1959 the emphasis by industry has been largely in the research and development of aircraft, engines and components to meet the specific military and civil requirements of Canada. This effort has resulted in the design, development and production of such aircraft and ancillary items as the Chipmunk, Beaver, Otter, CF-100, Orenda engines, Arrow, Iroquois engines, Caribou and CL-44, as well as the production by licence of aircraft of foreign design. The total number of aircraft built in this period is well over 5,000.

Now to become contemporary for a moment, the industry suffered a severe setback in early 1959 when, due to economic and other considerations, the design, development and production of the Arrow aircraft, Iroquois engine and related equipment was terminated.

†Dinner address read at the Annual General Meeting of the C.A.I. in Ottawa on the 24th May, 1960.
*President.

As many of you well know, this decision had a tremendous impact, especially in the design and development area, and many of our top scientists and engineers were obliged to seek employment in the UK and the USA. During the past year, the industry has been feeling its way in an attempt to determine the path that must be followed. Many firms who were not obliged to expend all their effort in the military market have increased their emphasis in the civilian market and have also attempted to diversify. The government has taken some action in an attempt to fill the vacuum in the military area by their development and production sharing programme. Success in the latter is at this point an unknown quantity but there is every hope, from industry and the government, that the Canadian industry may be able to participate in the huge North American defence market, both for development and subsequent production.

It is my opinion that the industry already has the basic requirement for success, having regard for the fact that products such as the CL-44 and the Caribou are without question the leaders in their respective fields. There is ample evidence to substantiate this opinion in the many studies, undertaken in foreign countries, which have been published. There are other promising products too, including the Pratt & Whitney PT-6 engine, Kenting's Aerial Survey Equipment, Computing Devices of Canada's navigational equipment and others too numerous to mention, which, it is hoped and expected, will also be the best available anywhere and at competitive prices. The one major fear existing is that foreign countries, by legislation or other means, will prevent entry of these products into their countries whilst enjoying free access to our markets. This type of discrimination must be eliminated and it goes without saying, the aim of our Association being to enhance and perpetuate aviation in Canada, that we will do all within our power to urge and ensure that Canadian manufacturers are given a fair deal in the marketing of their products both in our own and in other countries.

It is obvious that maintenance of the industry in Canada at its present or a higher level will require continued research and development. The statement often heard that Canada should abandon research and development and concentrate only on production is both absurd and impossible. Research and development capability, as some think, cannot be put in a deep-freeze and extracted at will; it is very evident in any industry that research and development is a continuous requirement if the industry is to live. The government has recognized this fact, in part at least, by the establishment of a research and development fund which, while on a year to year basis and not large, is nevertheless a step in the right direction. It is alarming that our research and development capability is decreasing by what has been called "our export of brains", in that no less than 700 engineers have emigrated to the USA alone in the past year. This trend must be stopped, and in fact reversed, if Canada is to continue to play a major role in the drama of world affairs.

As to the future, I am confident that an industry which expanded from 3,600 employees in 1939 to over 44,000 by 1945, contracted to 11,000 in 1946 and expanded again to over 35,000 by 1952 is one which has demonstrated its ability to roll with the punches and one which can face the future with spirit and determination.

The near hysteria created by the launching of earth satellites, wherein the uninformed were ready to completely abandon manned aircraft, has fortunately diminished to the point where even the most dedicated space enthusiast now admits that but few people are prepared to be placed in orbit and that in both the military and civilian areas manned aircraft are and will be a requirement to meet the many demands for at least a goodly number of years to come. With this in mind we must keep our tools sharpened and our minds alert to take advantage of each opportunity as it presents itself – and in fact perhaps to go further and create the opportunities through intensive research and development. By such means shall we not only survive but become healthier with the passage of time.

AIR TRANSPORT

On the air transport side, the industry has made steady and rapid growth from its birth in 1919. Following World War I former military aircraft were converted for so-called "commercial" use, such as it was, and the saga of bush flying began. The early aviation pioneers flew supplies into isolated lumbering and mining sites, acted as fire spotters and did some aerial surveying. Their passengers were the prospectors and trappers of the day and their destination – wilderness. Many tributes have been paid to these early birds – all of them richly deserved.

Less than ten years later, with the bush operators better organized, the Canadian government focussed its attention upon the creation of a transcontinental system and began an intensive airport construction programme. For a further decade, interrupted by, but also assisted by the depression, this programme struggled on and, in 1937, with the passage of the Trans-Canada Air Lines Act, a company was created for the operation of transcontinental and international air services.

Four years later, a number of independent air carriers flying into northern areas were consolidated into one company under Canadian Pacific Air Lines.

This marked the approximate half-way point in the brief but remarkable history of Canadian air transport. The next fifteen years witnessed an extraordinary increase in the number of scheduled and non-scheduled carriers as well as a multiplicity of specialty carriers and helicopter operators.

These days were not without their growing pains. Competition was fierce and revenues marginal. Many companies went out of business. One of the original purposes of the Association, which I represent today, was the establishment of a code of ethics among carriers so as to preserve proper competition but at the same time to eliminate cut-throat tactics. However one of the most important steps in the development of Canadian commercial air transport was the establishment, in 1944 by the government, of the Air Transport Board, with licensing and regulatory authority. From that time on there was a gradual improvement in the condition of the air transport industry, thanks in some degree to actions taken by the Board with respect to regulation and licensing of air carriers which resulted in a certain

measure of stabilization, protected the carriers against themselves in some instances and assisted the industry at large to be in a position to present a modest profit picture. I should like to emphasize that so far as commercial aviation in Canada is concerned a modest profit is in fact a virtual state of Utopia.

I would not wish it to be assumed from these remarks that there has been continuous sweetness and light between the air carriers and the ATB. There have been, and undoubtedly will continue to be, many honest differences of opinion as to what, if anything, should be done under a given set of circumstances. What I do stress is that it has been possible, and I am sure will continue to be possible, to sit down with the Board, thrash out problems of common interest and arrive at solutions benefiting not only the carriers but the public at large – for we must ever remember that the one and only justification for existence of the air transport industry is to serve the people of Canada as safely, efficiently and economically as is humanly possible.

The net result of the combined efforts of all during the period 1944 to 1958 is that there was an orderly improvement in air service; new areas were opened up and the uses of aircraft expanded by experienced and reliable carriers. The industry was struggling along, keeping its head barely above water in the wake of virtual cessation of DEW Line activity, when a new deluge came in the form of two policy decisions by the government within an eighteen month period, which changed the picture for the worse.

While a number of larger and regional carriers were awaiting with keen interest the results of a survey undertaken by the ATB to enquire into the possibilities of improving the position of regional carriers, it was decided by the government to issue licences, freely on request, to any applicant proposing to use aircraft up to 6,000 lb disposable load. This came at a time when few carriers were doing more than holding their own. Since the introduction of this policy the number of licensed carriers has increased appreciably, and coincidental therewith the net deficit of the Canadian air industry has risen from about half a million dollars in 1957 to almost three million at the end of 1959 – a clear-cut case of quantity lowering quality.

Lest I should appear overly critical or pessimistic let me say that the present state of uncertainty may be only a prelude to a new era of stability, if recommendations advanced by our Association are adopted by the government. We believe a sound and well defined Canadian air transport policy of a long term nature based upon the principle of economic feasibility, must be evolved. The starting point might well be decisions to be arrived at in the Regional Survey by the ATB. At the same time we have seen recent consolidations and mergers resulting in larger and, it is hoped, stronger companies, and this trend may well continue. The secondary carriers are now looking to turboprop aircraft as replacements for their fleets and this in itself reflects a sign of their confidence in the future. The introduction of the large pure jets by the two major airlines is an illustration of the ability of Canadian aviation to keep abreast of other countries and a measure of their confidence in the expanded use of air transportation by the travelling public.

As we all know, the jet age has not been introduced without its headaches but it is a tribute to the Department of Transport that it has kept pace with technological progress. True, we have heard criticism of the airport terminal building programme but let us pause to give credit where it is due. The Department is constantly meeting the ever increasing demand for improvement of meteorological services, air traffic control, surveillance radar, radio aids to navigation and runways to handle bigger and faster aircraft.

In the so-called bush carrier field, which I prefer to label the northern development field, the concept is also changing. Operators, in addition to flying Cessnas, Beavers, Norsemen and Otters, are now utilizing bigger aircraft with payloads hitherto considered unfeasible for northern operations. In addition there are also some 200 helicopters operating in Canada, mostly in remote areas. Yes, the new challenge of the north is being met and air transport has been, is, and will be in the forefront in the fields of exploration, survey, development and supply.

THE FUTURE

I have given you only a capsule version of what has gone before and what the situation is today. Now – to offer a short comment on the future. It is obvious that Canada, in common with other countries, has gone ahead with full throttle into the jet age and the industry is now looking forward – with both anticipation and apprehension – to the next stage, i.e. commercial supersonic flight. While this may be glamorous when it arrives, it will only have application to long-range flights and the bulk of the air transport needs of the country will continue to be taken care of by more prosaic means. As I mentioned previously, there has been a trend by secondary carriers towards the acquisition of turboprop aircraft – and undoubtedly this trend will continue. Naturally there are hopes for the development of commercially feasible VTOL aircraft and helicopters to provide more efficiently for the movement of relatively short-haul, intercity traffic; and with the continued development of northern areas there will, of course, be a further gradual switch from floats to the conventional types of wheeled aircraft in these areas. In closing this chapter let me say that, whatever the future may hold, you may be sure that Canadian air transport will continue to progress in tune with the times and the job at hand.

I make these comments relating to the future with all due deference to an article which appeared in a recent issue of *Maclean's* entitled "Is Air Travel Obsolete?" Far be it from me to enter into a debate with such an eminent student of air transportation as the author of this article: but one observation I must and will make – that if the aviation industry made as many serious factual mistakes on any of its projects as did the author of the article, it would indeed be headed for obsolescence. Of course the industry is faced with many problems which must be solved – and there is no room for complacency or conceit within it. Nevertheless one has only to look at the record to see what has been done, particularly since the end of World War II, to recognize that much progress has been made and that the air transportation industry is still dynamic rather than static. As with any other line of endeavour, the future depends upon our collective ability to innovate and to improve and also to overcome

problems as they arise, or better still to anticipate these problems. Only when we fail in these respects will there be danger that air transportation will become obsolete. I suggest humbly this time is not yet in sight.

CANADIAN AERONAUTICAL INSTITUTE

And now, in conclusion, and to swing from the ridiculous to the sublime, I would most certainly be remiss if I did not tell you of the respect in which your Institute and its members are held by the companies represented in AITA. We know what your grades mean in the profession of aeronautics. We know that you have a careful and thorough grading procedure, which involves references and a close study of each case by a committee of your senior men. We know that "Membership" and "Associate Fellowship" and the others denote certain degrees of standing in aeronautics; they give a broad indication of what a man is worth. I think our industry might save itself a lot of trouble by paying more attention to CAI membership grades.

Your Journal, in its few short years of existence, has filled a need in the dissemination of technical information among those engaged in aviation in Canada. I think it could do even more to show the aeronautical world the sort of work that is being done in Canada. I understand it has a distribution among the technical libraries abroad and we would do well to use it for the publication of the results of some of our research work, which I believe to be second to none in quality, if not in quantity. We should be proud of this work done in our industry, university and government establishments, and papers should be submitted, whenever possible, for publication in the CANADIAN AERONAUTICAL JOURNAL. I believe it should be the chosen medium of every Canadian scientist and engineer seeking professional recognition of his work. We have no comparable publication in this country.

Two years ago, shortly after the launching of the first Sputnik, there was a surge of interest in the realm of astronautics. At that time some people became so fascinated by this demonstration of the possibilities of the future that they did not pay sufficient attention to conditions on the way immediately ahead; in consequence we have run into some heavy weather while our eyes have remained focussed on the distant stretches. Now that we have been jolted back to the realities of life, there is a tendency for the pendulum to swing the other way. Industry, with its very proper concern for dollars and cents, today and tomorrow and tomorrow, is not too disposed toward the devotion of a lot of thought to the very remote theories which may have no practical application.

We are therefore impressed by the approach the Institute has adopted and that you are concerning yourself first and foremost with today's problems of Canadian aviation – or perhaps I should say tomorrow's problems; for as engineers you are ever looking forward. But secondly, as scientists, you are looking further afield, regarding the penetration of space as a natural extension of aeronautics and studying it seriously as a field of research, all of which will have an ultimate bearing on forms of flight, both in and beyond the atmosphere. In the words of the layman, while your eyes may be fixed on the stars, your feet are planted firmly on the ground. This is indeed a balanced and responsible approach, worthy of your profession.

SPACE ASTRONOMY†

by Dr. J. L. Locke*

Dominion Radio Astrophysical Observatory

SUMMARY

Until very recently, astronomical observations could be made only with instruments situated at or near the surface of the earth. The accuracy and extent of such observations are severely limited by the terrestrial environment. Now, for the first time, simple unmanned observatories can be placed in outer space and, in the near future, more extensive experiments will be undertaken.

The paper discusses the limitations imposed on earth-bound astronomers, the importance of additional information which can be expected from observatories in space and some of the difficulties which must be overcome.

INTRODUCTION

THE problems of launching large instrumented vehicles into space, of guiding and tracking them and of relaying the information back to earth are being solved with such rapidity that the astronomer can look forward to the establishment of space observatories within the next few years. Already the far side of the moon has been photographed from an artificial satellite[1] and it will be feasible soon to place accurately controlled telescopes and spectrographs in space. There are a great many technical difficulties to be overcome before refined observations will be possible but these problems are capable of solution.

It is likely that measurements will be made of the surfaces of the moon and nearer planets by the landing of instrumented, or even manned, vehicles on their surfaces. However, most observations will be made from space stations in satellite orbits. It will not be necessary to man these observatories – and, for economic reasons, undesirable. The instruments can be controlled equally well by an observer on earth and the data communicated back to him. In this paper, therefore, it will not be necessary to consider space travel and the physiological problems it involves.

It would seem opportune at this time to review the advantages to be gained from a space observatory and consider what experiments are contemplated. It should be borne in mind, however, that the course of the research will be dictated by the results and the great discoveries will be ones that have not been anticipated. Already we have an example of such a discovery in studies of the outer regions of the earth's atmosphere, the discovery of the Van Allen radiation belts[2].

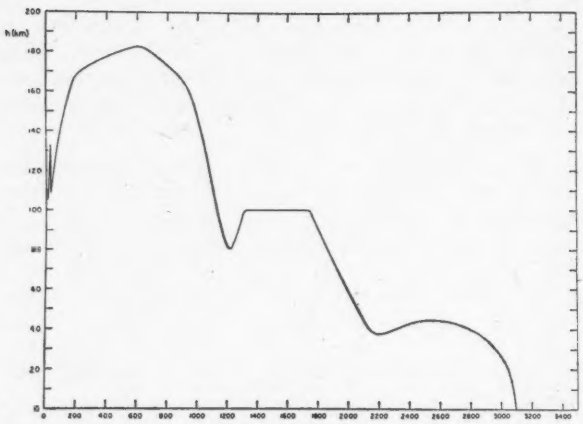

Figure 1

The height *h* in kilometres at which the remaining atmosphere becomes 50% transparent plotted as a function of wavelength in angstroms.

TERRESTRIAL ATMOSPHERIC LIMITATIONS

Astronomical observations from the surface of the earth are severely restricted for three reasons:

(1) Observations are limited to those regions of the spectrum for which the atmosphere is transparent. The atmosphere is virtually opaque to all wavelengths shorter than about 3000A. Thus all the x-ray region and the far ultraviolet region, in which are located many spectral lines of astrophysical interest, are inaccessible to the earth-bound astronomer. The general nature of the absorption is shown in Figure 1[3], in which the height at which the remaining atmosphere is 50 per cent transparent is plotted as a function of wavelength. From 3000A to 1800A the absorption is due to ozone; from 1800A to 1000A it is caused mainly by molecular oxygen and nitrogen; below 1000A the absorption arises from atomic oxygen and nitrogen existing above about 100 km.

In the infrared and microwave region (10,000A to a few millimetres) the available spectrum is restricted by absorption bands of atmospheric molecules. At wavelengths longer than about 20 metres the radiation is again absorbed by the atmosphere, this time by the ionosphere. Radio astronomy is therefore restricted to the wavelength region from the millimetre band to 20 metres.

(2) Motions in the atmosphere produce a spreading of the image at the focus of the telescope, limiting the resolution obtainable. This effect, which is termed "atmospheric seeing" by the optical astronomer, is vari-

†Paper read at the Mid-season Meeting of the C.A.I. in Edmonton on the 19th February, 1960.

*Officer-in-Charge

able but, even at times of best seeing, the resolving power of large optical telescopes is determined solely by the atmosphere. For example, the 200 inch telescope at Mount Palomar has a theoretical resolution of 0.02 second of arc but the seeing is seldom good enough to produce images less than 1.00 second of arc in diameter. Seeing not only reduces the photographic definition but reduces the accuracy of photometric and astronometric measurements and produces light loss at the slits of spectrographs.

The effect of seeing on the appearance of a sunspot photograph is shown in Figure 2. The three photographs were taken with the same telescope under different atmospheric conditions. The advantage to be gained by the use of telescopes above the atmosphere is illustrated in Figure 3. This photograph was taken with a remotely controlled 12 inch telescope mounted in a balloon at an altitude of 80,000 ft by Dr. Martin Schwarzschild of Princeton University[4]. In this photograph the theoretical resolution of the 12 inch telescope was achieved.

(3) The light of the night sky places a limit on the magnitude of the faintest star which can be photographed with a given telescope. To be detected, the telescope must produce an image which is sufficiently brighter than the sky background to give the necessary contrast. There is therefore a limit to the photographic exposure time which may profitably be used since further exposure will not increase the contrast. While not all the light of the night sky is produced in the atmosphere it is thought that the airglow contributes about half. The remainder arises from zodiacal light and interstellar scrattering of starlight and this will eventually determine the limiting magnitude of the space telescope.

SPACE TELESCOPE

The design of astronomical instruments for space stations presents great difficulties. An orbital telescope must not only operate by remote control but must function, without repair, for a long period of time.

The optical parts of the telescope must withstand the large acceleration forces and arrive in orbit with its delicate adjustments preserved. Once in orbit the residual angular momenta must be reduced to zero and the telescope accurately pointed at the object to be studied. If the resolution to be achieved by the spatial telescope is

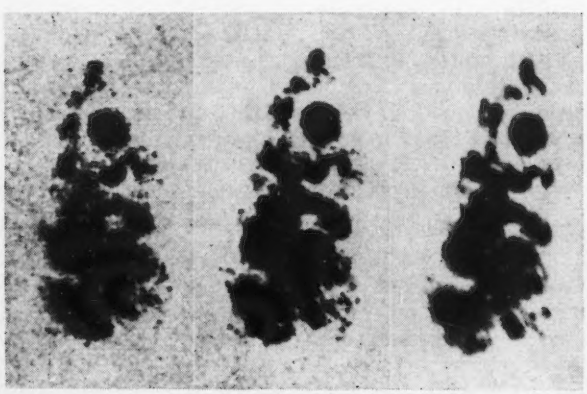

Figure 2
Three photographs of a large sunspot region taken with the same telescope at different times, illustrating the serious limitations which may be imposed on photographic definition by atmospheric conditions.

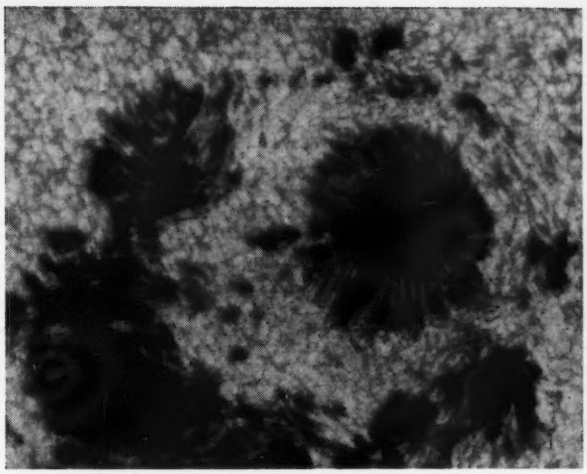

Figure 3
Photograph of a small region of the solar surface obtained by a remotely controlled telescope mounted in a balloon at an altitude of 80,000 ft. The large single spot is approximately 8000 miles in diameter.

to be superior to that obtainable from earth, the telescope must be guided with an accuracy of 0.1 second of arc or better.

In orbit, the principal forces affecting the performance of the telescope will be thermal in origin. One side of the telescope will be heated by the sun and the thermal gradients produced could seriously impair the optical adjustments.

The most useful orbit for astronomical observation will perhaps be one with a period of about 24 hours and inclined at a small angle to the equator. Such a satellite would remain accessible from one control station on earth for several days without interruption.

THE SUN

Because the sun is the closest star and has a profound effect on terrestrial conditions its observation from satellites is of prime importance. In recent years observations of the sun have been made from rockets and balloons but many solar features are variable and hence continuous observations extending over long periods of time are required.

Observations of the sun in the ultraviolet require a vehicle at a height of at least 170 km. It was not until 1946, when V2 rockets were used for research purposes[5] that anything was known of the solar spectrum below 2850A. The first spectra were obtained with instruments which relied upon the rolling and yawing of the rocket to cause sunlight to enter the spectrograph slit[6]. Later, a biaxial pointing control was developed with an accuracy of 1 or 2 minutes of arc[7]. The problem of pointing should be somewhat easier from a satellite whose angular momenta have been reduced to zero.

In the United States, the National Aeronautics and Space Administration is sponsoring a project under the direction of Dr. L. Goldberg, University of Michigan, to obtain ultraviolet spectra of small identifiable solar features. Three spectrographs will record the ultraviolet spectrum from 80 to 3000Å with a resolution on the disk of 6 seconds of arc.

The most important line in the solar ultraviolet spectrum above 1000A is the Lyman-α line of hydrogen at 1215A. This emission line accounts for about 94% of the radiation in the 1050 to 1300A region[8] and is probably the dominant factor in the production of the ionospheric D-layer. Although it is expected that the total radiation in the Lyman-α line varies with daily sunspot activity and sunspot cycle, measurements from rockets are inconclusive. To check this point, Explorer VII launched in October, 1959, contained ion counters to monitor the total flux of the Lyman-α radiation.

The first detailed photograph of the sun in the light of Lyman-α[9] shows that the radiation is most intense in the neighbourhood of active solar regions. It would be of great interest to have a continuous record of the appearance of the solar disk in Lyman-α during a flare or outburst, such as is available for the Balmer-α line (6563A). The satellite-based telescope has a distinct advantage over short-lived rockets for this type of observation. From the limited rocket data now available it would seem that the Lyman-α radiation is not sufficiently enhanced during a flare to account for the anomalous lowering of the D-layer which follows a flare.

Measurement of solar x-ray intensities are also required during flares. Rocket results indicate that during a flare the intensity of radiation in the 2-10A region increases and that x-rays penetrate to lower altitudes. The x-ray radiation may therefore be responsible for the lowering of the D-layer following a flare. Here again, continuous records are necessary and equipment for this purpose was installed in Explorer VII and Vanguard III.

LUNAR AND PLANETARY OBSERVATIONS

Close approaches to the moon and planets will enable photographs to be taken showing much greater surface detail than those taken from the ground. A Soviet lunar probe has already photographed the far side of the moon but, great as this achievement is, photographs of greater definition are required. Photographs of portions of the near side of the moon showing the finest possible detail will be of great value in interpreting the lunar features. Close approaches to the planets will also make possible a determination of their magnetic fields.

Spectra of the planets, as observed from a space station, will enable the composition of their atmospheres to be determined for the first time. The determination of their composition is extremely difficult from the surface of the earth because of absorption in our atmosphere. For example, only CO_2 is known on Mars; the amount of nitrogen and water vapour is unknown. Infrared spectra may also settle the question of the existence of some form of life on Mars. Instruments landed on the surface of the planets could carry out a great variety of experiments including photography of the surface, seismic measurements and chemical and micro-biological analyses. In this type of operation, however, care must be taken not to contaminate the planet before the necessary observations have been made.

Spectral observations of Venus will settle the question as to whether or not the observed clouds are composed of water drops. A close approach could be used to determine the rotational velocity of Venus which at present is unknown.

SKY SURVEYS

One of the most important projects to be undertaken from satellites will be the mapping of the sky in the ultraviolet and infrared. Far ultraviolet radiation from celestial sources was first detected during a rocket flight in 1956[10]. Subsequent observations[11] have shown that these sources are a new class of nebulosity having high surface brightness in the ultraviolet. The observations were made with photometers responding to the wavelength region 1225-1350A and accepted radiation within a 3° field. The rolling and yawing of the rocket caused the photometers to scan the sky. The outlines of the brighter regions are shown in Figure 4. Seven nebulosities were detected, one near the star α-Virginis having a diameter of more than 20°. Some of the ultraviolet nebulae coincide with known optical nebulae but are considerably larger and brighter. Others have no visible identifications.

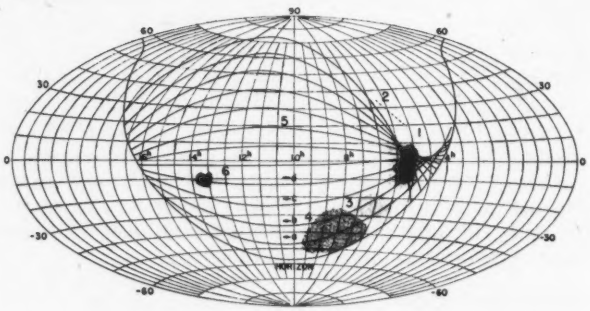

Figure 4
Far ultraviolet map of the sky. The observations were taken by photometers responding to the wavelength region 1225-1350A, mounted in the nosecone of a rocket. The positions of seven nebulosities are indicated.

Photoelectric photometry and high resolution photography of stars should be possible and both projects are under consideration by NASA. External galaxies should also be interesting objects for study in the light of Lyman-α. It might be thought at first that they would be difficult to observe since the sky will be bright due to scattering by galactic hydrogen. However, distant galaxies will have their Lyman-α radiation Doppler shifted according to the velocity-distance relation for an expanding universe, and thus their radiation will penetrate the interstellar gas of our own galaxy. A means may, therefore, be available for studying very distant galaxies so important in cosmology.

STELLAR SPECTROSCOPY

The strongest spectral lines of the most abundant elements in the universe lie in the ultraviolet region. The strengths and profiles of these lines in stars are of great interest in the study of stellar atmospheres. A spectrograph is being designed under the sponsorship of NASA for this purpose. It is to provide one-angstrom resolution and be fed by a 30 inch reflecting telescope.

The study of ultraviolet interstellar absorption lines is also a promising field. In particular, spectra in this region may yield data on the abundance of molecular

hydrogen in interstellar space, about which there is only speculation at the present time.

COSMIC RAYS

The study of cosmic rays above the atmosphere is important not only because it will provide data for interpreting their origin but because they provide a source of particles of much greater energy than those which are likely to be generated on earth within the next decade or two. The satellite provides a laboratory in which experiments involving long observing times can be carried out. The instrumentation of Explorer VII included equipment for the measurement of cosmic radiation. Bursts and also sudden decreases in cosmic ray intensity have been recorded by these instruments. The causes of these effects are uncertain but they seem to originate in the Van Allen belts[12] (Figure 5).

RADIO ASTRONOMY

Measurements of the energy emitted by radio sources at frequencies above and below those reaching the surface of the earth are required for theoretical studies of the origin of the emission[13]. For low frequency work large aerials will eventually be necessary. The construction of these in space is a difficult problem but not impossible since they will not be affected by wind and gravitational forces. For preliminary work small aerials will be satisfactory. Equipment to measure the radiation at 3 mc/s has been developed by the Defence Research Board of Canada[14]. It is hoped that this equipment will be flown in a US satellite in the near future.

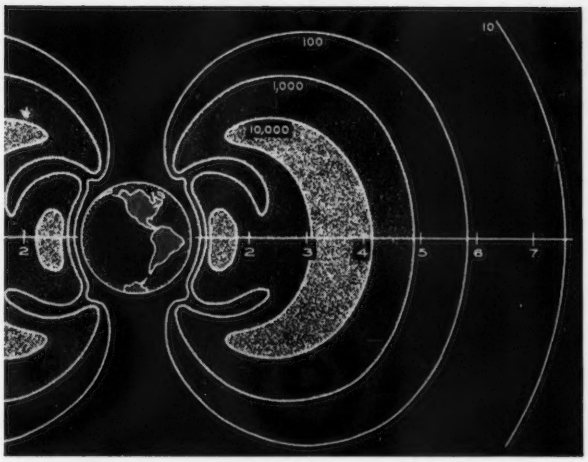

Figure 5
Simplified picture of the Van Allen radiation belts, with distances given in earth radii and radiation intensity in counts per second. It is expected that the positions of the zones of maximum intensity vary over the 11-year sunspot cycle.

CONCLUSION

This paper has summarized some of the immediate astronomical problems capable of solution from space vehicles. It is not difficult to think of many more. Most of them require smaller equipment than will ultimately be possible. When the technical difficulties have been overcome, one can imagine space observatories equipped with truly large telescopes and associated equipment.

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TRANSPORTATION — CATALYST TO PROGRESS†

by B. W. Torell*

Trans-Canada Air Lines

INTRODUCTION

In the primitive era of mankind, woman was the major medium of transport. She gathered the wood, fetched the water and dug for roots and berries. On the trail she carried all the household gear. It was necessary for the man to be free of burden save for his weapons. He was the hunter and the fighter.

Animals

The first stride in the improvement of transportation methods was through the use of the dog, the ox, the reindeer, the horse, the donkey, the camel and the elephant. This change was enhanced by the fact that most of the world's primitive beasts of burden were milk yielding.

Sleds

The next step was the addition of sleds which greatly improved the productivity of these animals.

Wheel

The next development which is claimed to be one of the greatest, if not *the* greatest, of steps towards the civilization of primitive people was the invention of the wheel. There is a strong case of opposition to this statement by a group who believe that the discovery of the axle was just as important. Regardless, in this country the wheel and the axle are not as primitive discoveries as you might imagine although two-wheeled chariots were prevalent in Assyria and Egypt. There actually were no wheeled vehicles in America until after the arrival of the European discoverers in the 15th century.

Roads

Rome was the first nation on record to develop an extensive system of roads. Improvement in the methods of water and land transportation was a potent force in bringing the change from the feudal to the national organization of society. When the Roman power was overthrown and road building ceased in Britain, Gaul and Mediterranean lands, economic, political and social life once again became localized.

It was not until the 18th century that a systemized development of roads was once again undertaken in Britain and Europe. In 1760, Britain commissioned a number of turnpike companies to build roads which were paid for by tolls. In 1763, a stagecoach trip from London to Edinburgh required 14 days.

Railways—Airlines

The introduction of the railway in 1825 brought with it many great advantages; it provided man with a powerful tool for expanding his economic and social horizon. The railways followed and supplemented by the steamship, the telegraph, the telephone, the automobile, the radio and the aircraft transformed the world. Changes came with accelerated rapidity so that there appears no limit to the degree of world unity made possible by these developments in communication and transportation.

†Paper read at a meeting of the Calgary Branch of the C.A.I. on the 29th March, 1960.

*Supervisor of Engineering, Winnipeg

BEGINNING OF THE AIRLINES

Aviation, then, is but one chapter and I believe the most exciting and the fastest changing in the story of transportation.

The kernel of the current air transportation industry burst into life with the first powered aircraft flight by Orville Wright slightly more than 50 years ago. In Canada the majority of flying in the 1920's was carried out in the north and resulted in the development of our northern resources. Some names that are associated with this era are Wop May, Punch Dickens, Grant McConachie and Doc Oaks. There was some commercial flying in the United States in the 1920's. United Airlines had its beginning in 1930 with the amalgamation of four small airlines. That was also the year that American Airlines' name was introduced. TWA came into being in 1931, Air France in 1933, TCA in 1937 and so the story continued.

Airlines growth

Since those early beginnings, airlines have grown very rapidly, indicating the degree to which this form of transportation has met a need. Three yardsticks that are commonly used to outline the growth of an airline are the number of passengers carried, ton miles flown and number of employees in the airline.

US airlines

In the United States the total number of passengers carried by the airlines rose over 100% between 1951 and 1957.

In the same time, the ton miles rose to slightly over seven billion, a gain of 115%, and the number of airline employees rose 32% to almost 127,000.

European airlines

Statistics for the 15 major European airlines that carried 90% of the European traffic show quite a remarkable gain in the number of passengers carried. There was an increase of almost 100% in four years, 1952 to 1956, to a total of slightly over 10 million. Ton miles in this period doubled and employees gradually rose to just under 100,000.

Canadian airlines

The Canadian picture is quite similar, a little better percentage-wise than the US figure, and a little less than the European figure. It is significant to note that the rate of increase of airline passengers carried was almost three times the average rate of increase of the Canadian gross national product.

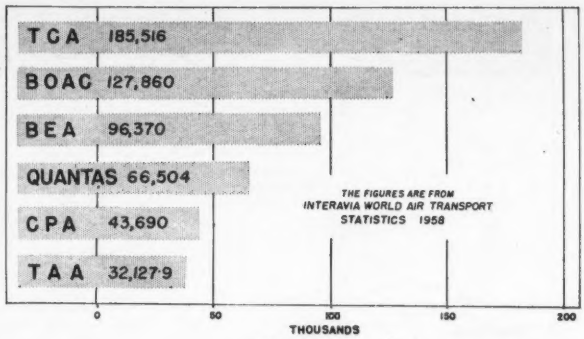

Figure 1
Commonwealth airlines—revenue ton miles

Within the British Commonwealth, Canada holds a unique place. TCA is the largest Commonwealth airline (Figure 1) and holds 7th place on a passenger mile basis and 8th place on a ton mile basis, among all the free world airlines.

The free world airlines, in 1959, flew approximately 114 billion seat miles, or enough to carry every man, woman and child in Calgary (approximately 202,000) around the world 22 times.

Comparison of growth in major common carriers

During 1956, US airlines took first place over the railways competing for inter-city passenger traffic (Figure 2). During 1958, the airlines substantially led all the common carriers and flew more than 25 billion passenger miles – 39% more than the railways and 78% more than the buses.

In Canada, 1957, TCA's passenger revenue exceeded, for the first time, the combined passenger revenues of the Canadian National and the Canadian Pacific Railways.

Your grandson will have to ask you how it felt to ride on a train. The opportunity of his obtaining this information first-hand won't be available to him.

North Atlantic steamship comparison

On the North Atlantic, which is called the Blue Ribbon Route, twelve foreign lines, Pan American, TWA and TCA compete, and carried a total of slightly more than one million passengers in 1957 (Figure 3). This was only a few thousand less than the total of sea voyagers.

In 1958, the airlines led North Atlantic ship passenger totals by a wide margin. During 1959, twice as many people crossed the North Atlantic by air as by sea.

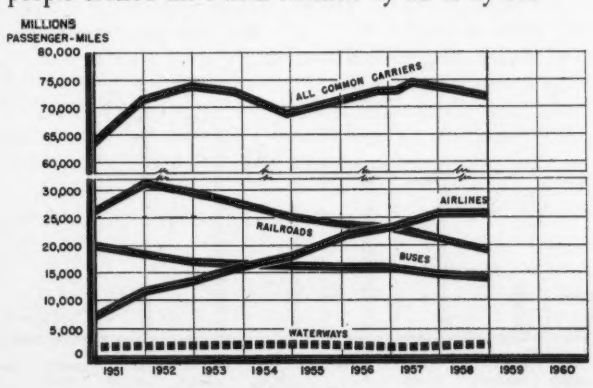

Figure 2
US domestic inter-city passenger travel market of common carriers

Market penetration

An interesting comparison is the degree to which the airlines have penetrated into the potential market. In 1958 the total population of the USA was approximately 174 million and the airlines carried over 49 million passengers. Europe had a population of approximately 418 million in 1958 and recorded 12.7 million passengers.

Canada, in the same year, had a population of approximately 17.3 million and carried 4.2 million passengers. This would seem to indicate that in Canada and the USA, roughly every fourth person is an airline passenger, while in Europe every 33rd person has been won over to air transportation. This does not naturally follow as many

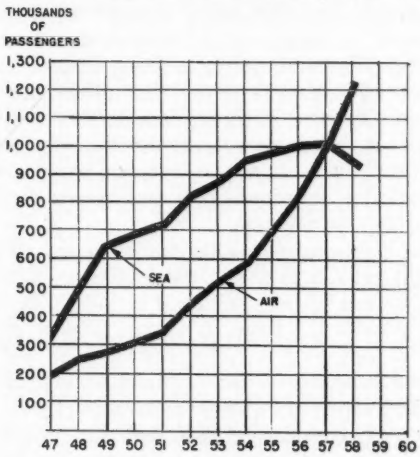

Figure 3
North Atlantic travel

airline passengers are repeat passengers. In the USA, for instance, not every fourth but every fifteenth person is an airline passenger and the proportion of passengers who have never travelled by air is still 75%. In spite of the fact that 7% of all trips made in the USA in 1957 were made by air, 88% of the air travelling will be done by previous air travellers. From one point of view, however, these figures are encouraging as they show that the potential market for air travel is still very wide.

Safety

Airline growth has not only been on the physical side. Growth has also taken place in the degree of safety associated with flying as well as in the speed and comfort. One rather startling statement concerning safety was made by Peter G. Masefield, Managing Director, The Bristol Aeroplane Company Limited, and President of the Royal Aeronautical Society, in September, 1948, and I quote:

> "Indeed, in the United States last year, statistics show that there were more people kicked to death by donkeys than were killed in Air Transport."

Since that time, the safety record has even improved to the point where travel by scheduled airlines is four times as safe as travelling in your automobile. Statistically, the most dangerous part of your airline trip is the taxi to and from the airport! If you are plagued by a mother-in-law, don't buy her an airline ticket. Just buy her her own car.

The UK's airlines' safety record is slightly below that of North American. Unfortunately, in 1959, the

safety record in the USA deteriorated somewhat due, mainly, to four aircraft accidents but their record is still relatively good.

In Canada, in 11 of the past 13 years, TCA has operated its fleet without a single fatality.

It may seem illogical to you but the Atlantic airline route has a considerably better safety record than domestic routes. Flying the Atlantic is statistically safer than walking, riding a bicycle and some 15 times as safe as driving your motor car.

Toronto has more traffic deaths in a single year than were caused by all countries' airlines to foreign parts.

The safety record of airlines in the future will probably be even better as a result of more efficient design on the part of accessory and aircraft manufacturers, better traffic control facilities, more accurate weather forecasting and more adequate airports. The turbine type engine will boost reliability statistics considerably itself. For instance, TCA's experience shows that the Dart turboprop engine in the Viscount, in the first nine months of 1958, was, statistically, over four times as reliable as the Wright engine in the Constellation.

US jet engine performance has exceeded all predictions. The reliable P & W 2800 engines, which power many piston engined aircraft such as the DC-6, Convair etc, had nearly 2.5 times as many failures per 1000 hours of operation (3 vs 1.25) as the P & W J57 engine used on some versions of the DC-8 and Boeing 707 during the first 12 months of its commercial service.

An FAA spokesman has indicated that the jet engine experience of Pan American and TWA with the Boeing 707 is about 20 times better than their experience with most piston engines. TWA operated 48,350 engine hours with only 2 precautionary shut-downs and PAA 64,000 engine hours with only 5 precautionary shut-downs — Air France has indicated a figure of 0.7 engine failures per 1000 hours in their Caravelles as compared with 2.9 for their piston engined aircraft.

FINANCIAL CONDITION OF THE AIRLINES

With the rapid growth of the airlines and public acceptance of flying, it should follow that the airlines would be in a sound financial position. Let us take a look at the financial side.

Aircraft costs

The airlines have undergone a number of major re-equipment programs since they commenced operation and the majority of them have taken place since the last war. Each re-equipment program has resulted in higher aircraft costs for the airlines (Figure 4). For instance, the DC-3/Lockheed Lodestar type aircraft cost in the neighborhood of $125,000 to $150,000; the next group of aircraft such as the North Star, Convair CU240, Martin 404 and DC-4 ranged in price between $500,000 and $750,000 each. The Douglas DC-6 and the 749 series Constellations cost almost 1 million dollars each; the Douglas DC-7 and the Lockheed 1049, which were the most recent acquisitions of the airlines, involved an investment of nearly 2 million, while the long-range jet aircraft, such as the DC-8, with spares, will cost TCA over 6 million each.

Costs—material and labour

Costs of the ingredients of transportation, as well as costs for equipment, have been rising steadily. In the

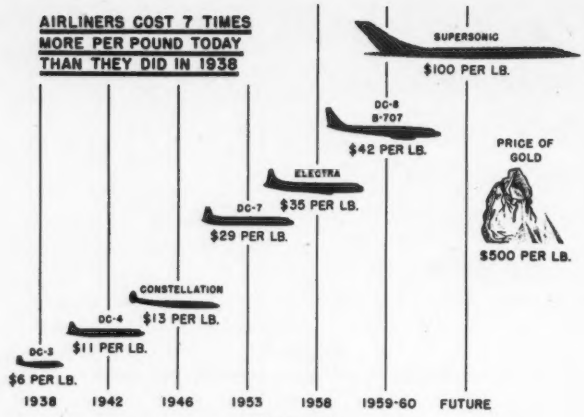

Figure 4

USA fuel and oil prices have increased 41%, maintenance and material prices 44% and the average salaries 78% since 1947. The Canadian picture is, roughly, the same. As an example of rising labor costs, one US airline has reported that it will pay their DC-8 Captains up to $30,000 a year which, as one magazine put it, will result in each getting his own weight in gold in a little over 2½ years.

FINANCIAL

Revenue and profit

The gross revenue of the airlines, consistent with their growth, has shown a steady and remarkable rise. Passenger revenues for the airlines both in the USA and Canada, exceed those of the railways.

In spite of the fact that between 1952 and 1957 US airline revenues have almost doubled, profits fell by more than one-half — the cost of the ingredients going into air transportation has been increasing faster than the increase in revenue. As a result, three US airlines, Capital, TWA and Northeast, in 1957, and Northeast, in 1958, posted deficits; American, Eastern and United's profits in 1958, though up slightly in 1957, dropped again, roughly 50% below the 1956 figures. TCA's revenue in 1958 was 33% over 1956 but profits were down 65%. The first look at the 1959 picture is indeed brighter, particularly in airlines that have a pure jet operation.

US fares

In spite of rising costs and shrinking profits, airline fares at the beginning of 1958, in the USA, had increased only 1.9% since 1938. During this same period, US railway fares increased 46%, and all other products to an even greater degree, as shown in Figure 5.

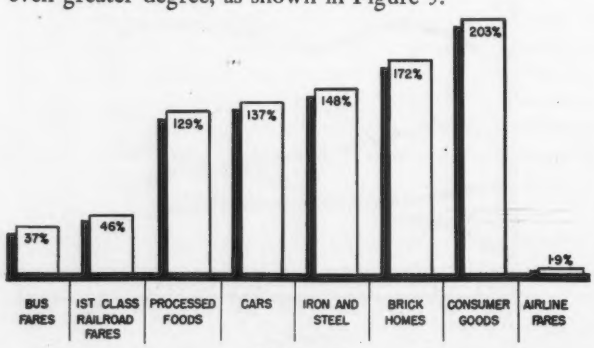

Figure 5
US comparative price increases—1938 to 1957

The US airlines, as a result, requested an increase in passenger fares ranging from 12% to 17% last year. The Civil Aeronautics Board (CAB) granted an interim boost of $1.00 per ticket, plus 4%, roughly equalling a total of 6%, in February of 1958.

In October, 1958, the CAB permitted the domestic airlines to eliminate the round trip discount of 5%, remove the free stop-over privileges and reduce the discount for family dependent travel from 50% to 33⅓%. With these two increases, US airline fares are still only 3.2% over 1939 levels.

CAB have just tentatively approved an International Air Transport Association (IATA) resolution increasing first-class fares by 3% to 8% and the adoption of jet surcharges ranging from $2 to $28.

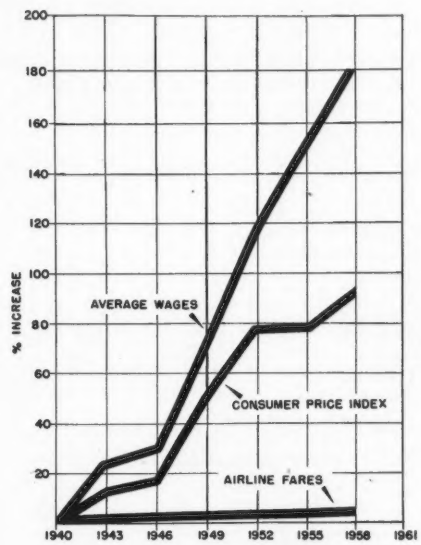

Figure 6
Canadian wages, prices and airline fares

In Canada, the consumer price index, since 1940, has almost doubled (Figure 6). Airline fares have stayed relatively the same, while the average worker now has (theoretically, of course) 2.8 times as much money as he had in 1940.

During the period 1948 to 1957, TCA fares were reduced 6%. On January 1, 1958, tourist fares were reduced an average of 13%.

At a meeting of the Sessional Committee in May 1958, Mr. McGregor, TCA's President, indicated that it is not TCA's policy to have large profits. Any threat of a large profit after paying the required returns on capital investment will take the form of fare reduction.

TCA has also recently indicated that it will not initiate a surcharge on its jet aircraft fares.

Comparison of air and rail fares

On many inter-city trips, railways are, as the result of increased train fares, no longer able to compete with the airlines, especially when you consider that in longer journeys, meals must be paid for and that your time is worth money as well (Figure 7).

For instance, between Montreal and Moncton, both coach and first-class air service fares are roughly $3.00

CITIES	FARES (DOLLARS)				TIME (HOURS)	
	COACH		FIRST CLASS			
	AIR	RAIL	AIR	RAIL*	AIR	RAIL
TORONTO-VANCOUVER	110.00	74.05	155.00	125.62	7:35	65:35
CALGARY-MONTREAL	99.00	73.65	142.00	105.25	9:10	51:00
MONTREAL-MONCTON	25.00	21.55	34.00	31.90	1:55	16:25
BOSTON-NEW YORK	10.80	9.42	13.65	16.60	:55	4:15
NEW YORK-WASHINGTON	12.55	8.78	16.00	18.46	1:00	3:50
WASHINGTON-NEW ORLEANS	45.00	34.49	67.55	61.59	3:11	24:10
DALLAS-SAN FRANCISCO	70.70	50.65	102.85	91.06	4:45	43:15
ST. LOUIS-LOS ANGELES	76.95	56.18	109.15	101.77	4:55	47:45

* INCLUDES LOWER BERTH

Figure 7
Comparison of rail and air fares with travel times—1958

above the equivalent rail fares and the time for rail is 16 houres 25 minutes, as compared with 1 hour 55 minutes for the airline. You must decide if 14 hours of your time is worth $3.00.

This then is the position of the airlines at the beginning of the jet age.

START OF THE JET AGE

The early stages of the jet age began with the introduction of the turboprop type aircraft. Several turboprop type aircraft are already in service, as you are well aware, such as the Viscount, the Britannia and the Lockheed Electra. TCA commenced the first turboprop aircraft service in North America with the Viscount in 1955. Some airline people, especially those not operating turboprop aircraft, seem to feel that the jet age will not start until the propeller is done away with. The cost of the turboprop aircraft available on the market does put it in the price class of long range reciprocating engined aircraft rather than the long range jet class. It is also not quite in the same speed range as the pure jet aircraft which, incidentally, will remain fairly constant for quite a period of time, as the next step up in speed is a large one — to supersonic speeds. Several pure jet type aircraft are also in service (Figure 8).

DATE	AIRLINE	ROUTE	TYPE OF JET
MAY 1952	B.O.A.C	LONDON-JOHANNESBURG	COMET 1
OCT. 1956	AEROFLOT	MOSCOW-TASHKENT	TU-104
OCT. 1958	B.O.A.C.	NEW YORK-LONDON	COMET 4
OCT. 1958	PAN AM.	NEW YORK-PARIS	BOEING 707
DEC. 1958	NATIONAL	NEW YORK-MIAMI	BOEING 707
JAN. 1959	AMERICAN	NEW YORK-LOS ANGELES	BOEING 707
MARCH 1959	T.W.A.	NEW YORK-SAN FRANCISCO	BOEING 707
MAY 1959	S.A.S.	COPENHAGEN-MOSCOW	CARAVELLE
MAY 1959	AIR FRANCE	PARIS-ISTANBUL	CARAVELLE
JUNE 1959	CONTINENTAL	CHICAGO-LOS ANGELES	BOEING 707
JULY 1959	QUANTAS	SYDNEY-SAN FRANCISCO	BOEING 707
SEPT. 1959	UNITED	N.Y.-L.A. & SAN FRANCISCO	DOUGLAS DC-8
SEPT. 1959	DELTA	NEW YORK-ATLANTA	DOUGLAS DC-8
DEC. 1959	BRANIFF	NEW YORK-DALLAS	BOEING 707
APRIL 1960	T.C.A.	MONTREAL-VANCOUVER	DOUGLAS DC-8

Figure 8
When the jets started flying

Jet age aircraft

Within the next three years, the present world airline fleet of aircraft will be supplemented by almost 1,000 new turbine powered aircraft that will cost over 2.8 billion dollars. This cost is almost the aggregate total cost of all the airplanes presently flying.

The fleets of the world airlines will contain turbine powered aircraft of three general types, the medium range turboprop powered aircraft – such as the Fairchild F27, the Handley-Page Herald and the Viscount – the long range turboprop type aircraft – such as the Britannia, Electra and Vanguard – and the medium and long range pure jet – such as the Boeing 707, Boeing 720, Caravelle, Comet, Convair 600, Convair 880, DC-8, DH 121, Vickers VC10 and VC11. As of January 1, 1960, the count was as follows: 495 medium range turboprops, 295 long range turboprops and 587 medium and long range pure jets.

Jet aircraft productivity

In spite of the high cost of a long range pure jet type aircraft – upwards of 6 million dollars – its productivity is such that the cost per passenger mile should be lower than that of many piston type aircraft; provided, of course, that enough passengers can be found to fill its larger size. As an example, the productivity of a DC-8 airliner is equivalent to three and a half DC-7's or eighteen DC-3's. A further comparison of the productivity in ton miles per hour of the major airline type aircraft available is shown in Figure 9.

Jet aircraft utilization

The conclusion reached at the 1958 Annual Air Transport Association's Engineering and Maintenance Conference, in Miami, was that the new jet transports must be kept in the air for an unprecedented percentage of time if they are to become an economic success. It won't do to allow a 6 million dollar machine to remain idle. Airlines and aircraft manufacturers estimated that the large turbojet transports will have to be operated between 10 to 11 hours a day if they are to make money, as compared with 8 to 9 hours a day for the Constellation, the DC-6 and the DC-7.

One DC-8 on the ground with mechanical trouble is roughly equivalent to three DC-6's out of service, as far as earning capacity for the airline is concerned. It is also equivalent to roughly five DC-6's in capital investment.

To meet this demand for more time in the air, airlines and aircraft manufacturers have devised programs which spread aircraft overhauls out to the point where aircraft probably will not be in a shop for more than 8 to 10 hours at any one time.

Eastern Air Lines is the first carrier to complete a continuous maintenance program approved by the Civil Aeronautics Administration (CAA). The Eastern overhaul system for the Lockheed Electra calls for the aircraft to be in the shop no more than 8 hours a day, except for a two-day period every 10,000 hours when the interior furnishings are removed for a thorough cleaning. Some engine manufacturers are recommending sectionalized maintenance in which the hot parts of the engine, which have the lowest life, are replaced as a section, while the cold and the compressors etc remain a much longer time before removal. The jet operators indicate satisfaction with the jet aircraft to date and they are achieving a utilization of, roughly, 8 to 9 hours a day, while the piston engined aircraft were in operation a number of years before this figure was reached.

Fleet financing

This situation of vanishing airline profits is not helping the airlines to finance their costly jet fleets. Many US airlines have found it extremely difficult to obtain the necessary 2.8 billion dollars financing for their new aircraft purchases. In order to open up the necessary avenues of financing, the airlines must have a fare level that will produce reasonable earnings. Reasonable earnings in turn would provide equity capital. The majority of airlines have completed arrangements for financing jet equipment, but with penalties.

Even those airlines that have completed long-term financing have no guarantee that the money will be available to the airlines when it is needed, because of the conditions that are incorporated in most agreements. For instance, in the United Air Lines' financing terms, the loan agreement requires that there will be no adverse changes in the business properties or the financial condi-

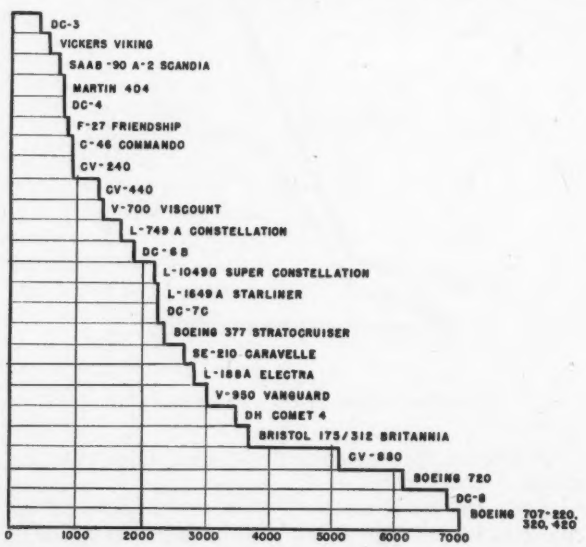

Figure 9
Air transport productivity (ton miles per hour)

tion of the company if the loan is to be consummated. The conditions also require the airline to maintain an asset/debt ratio that would not prevent it from undertaking its obligations or from paying its dividends. This, for United, was set at 100%.

In order for the airlines to cope with this situation, they are doing several things. Some airlines are attempting to lease aircraft and engines, some are attempting to farm out maintenance and overhaul work in order to reduce the need for additional capital expenditure. Several carriers, such as United Air Lines and Northwest, have persuaded Douglas and Lockheed to accept piston engined aircraft as trade-ins on turbine aircraft.

Airline facilities

The cost of new aircraft, material, labor and supplies is not the whole story. Sir William P. Hildred, Director

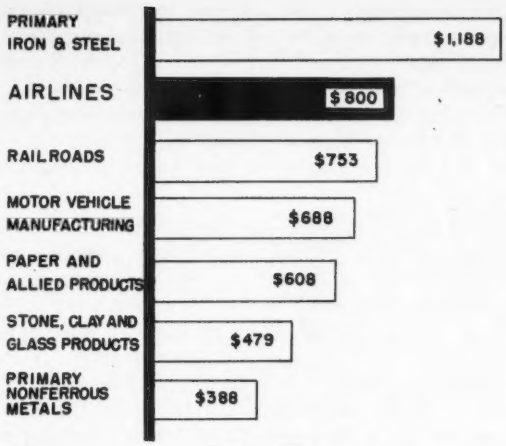

Figure 10
Anticipated expenditures for new plant and equipment by selected industries (1959 estimates given in millions of dollars)

General of IATA, feels that the airlines' facility program, training program etc will cost as much as the aircraft program. United Air Lines is expanding its maintenance facilities at San Francisco at a cost of 12 million dollars; PAA has moved into a new 15 million dollar facility at New York; TCA is just completing a 20 million dollar facility in Montreal, all for the new turbine aircraft fleets. Capital expenditures by the US airlines is second only to the primary iron and steel industry and ahead of the car manufacturing industry, railways etc (Figure 10).

Airways for jet aircraft

The introduction of jet transports will certainly bring about new operational, maintenance, administration and financial problems for the civil authorities and airline operators. Possibly one of the most serious problems is the inability of existing airways to handle large volumes of traffic safely in good and bad weather.

Sir William Hildred, speaking at the recent IATA Traffic Conference, made the statement concerning existing traffic control facilities:

> "It will certainly creak and grown under the impact of the increasingly large number of jet airliners going into service next year. A single week-end of bad weather under present traffic control procedures would be sufficient to force a jet fleet into providing a substantial quarterly deficit for the airline. Here there is no immediate relief in sight because of the long lead time in production and installation of airways and control equipment which is already ordered."

Airports for jet aircraft

A recent survey by the American Transport Association estimated that in the USA most airports will be inadequate within the next decade if traffic continues to expand at anything like the present rate (Figure 11). This will seriously affect the financial position of the airlines who, when they find that mainline routes are saturated, will be looking towards expansion of jet operation into their secondary routes in order to maintain necessary high aircraft utilization and passenger load factor.

Trans-Texas Airways, as an example, said that any aircraft other than the DC-3 put on their routes would be penalized economically because of the airport runways. An article in the March 9, 1959, issue of *Aviation Week* stated that there are only 25 airports in the USA upon which a jet airplane could take off and land with a reasonable load. A further article in the March 17, 1960, issue indicates that 18 cities can now fully accommodate jet aircraft and by the end of the year there will be an additional 17 that will have runways big enough to allow takeoff and landing. This is in a country where there are over 3,000 airports. This is by no means confined to the USA. Actually there are few airlines in the world that have runways of 10,000 ft and up, required for the jets. The ICAO survey in January of last year showed that out of 18 major airports on Far East routes, only one had runways of sufficient length for satisfactory jet operation.

In Canada at the present time, only Vancouver, Edmonton, Toronto, Goose Bay and Gander airports will allow DC-8 operation at its full gross weight on a hot day. Saskatoon, for instance, will restrict the aircraft to 215,000 lb, roughly two-thirds of its gross weight.

Because of runway limitations, Pan American has had to restrict operation of their Boeing 707's. Service from California to London has been curtailed by 10,000 lb, (one-third of its payload) because of runway lengths at Los Angeles (10,000 ft) and San Francisco (8,870 ft). Sir William Hildred recently stated that, if concrete were being poured now for the jet runways required to fully develop jet route patterns, it would be several years before these facilities would be available.

Airport expansion for jet age

Another problem is the lack of space for expansion. For instance, Heathrow at London, England, one of the finest airfields in the world, is now marginal as regards space for expansion. A similar situation existed in New York, where planners had to consider utilization of the possibility of one to three new sites.

If these problems of runway lengths, airway capacity etc are not solved quickly, they may prevent the airlines from using their long range jets efficiently and economically and very probably will make the difference between profit and loss.

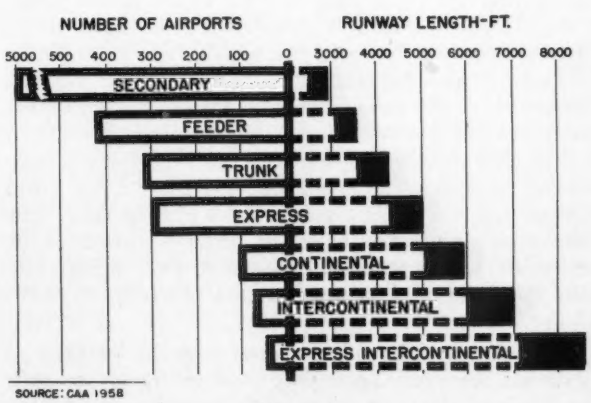

Figure 11
Summary of existing US airports—1958

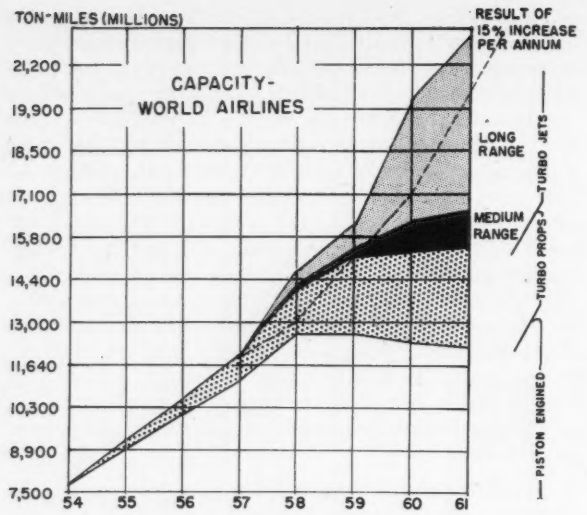

Figure 12
Capacity—world airlines

World jet fleet

A great deal of effort has been expended by ICAO and CAA in a survey of the problems connected with the operation of jet aircraft and an evaluation of the effect of the introduction of these aircraft on the airline passenger markets. The Air Transport Committee of ICAO in a report on these activities (Figure 12), submitted May 26, 1958, have estimated that the world airline potential capacity is on the average 23% higher than the demand in the period 1958 to 1960, is over 20% above the demand in 1961 – assuming a load factor of 59.4% has been necessary for economic operation and that there will be an attrition rate of the present piston fleet at 2% per year – and that traffic will increase at a rate of 15% per year. This situation, however, is highly theoretical as, for instance, the excess would disappear if 20% of the older piston aircraft were disposed of and the surplus could increase if world traffic does not increase at the rate of 15% per year. There are some current indications that the rate of increase may reduce somewhat.

Jet operation and US, Canadian and European markets

Passenger traffic in the USA in 1958, for the first time in aviation history, actually dropped below the 1957 level. In Canada it increased 8% and world passenger traffic increased only 2% as compared with 12% in 1957. Trans-Atlantic traffic increased 20%. This may be the first indication of the end of the rapid growth in the number of passengers carried, unless fares are lowered.

In view of these statistics and this experience, it may not be an easy matter to fill the jet aircraft of the world airlines but it is not beyond the realm of possibility. The European picture may be a little better as a result of the relatively low penetration of the European airlines into the European markets and Europe's "new age of abundance".

On the other hand, experience with the jet fleets to date has been very promising. Airlines flying jets such as National, Pan American and American, have been experiencing load factors in the middle and higher nineties.

IATA recently estimated that the development of European traffic capacity by 1961 will exceed 200% of the 1956 figure (Figure 13).

Importance of fare situation

One of the key elements and one of the most disputed in the rapid expansion of the airlines, their profit and losses, and the development of new markets, is the airline fare.

ICAO figures indicate that the world airlines showed an operating loss of 160 million dollars in 1958 contrasted with a 47 million dollar loss in 1957. The new jet fleets will produce extra profit or loss at a rate never realized with the piston aircraft. The increase in seat capacity of the world airlines requires a larger market. It seems the conviction of the world airlines that lower fares are needed to obtain the traffic necessary to fill the aircraft. The jet aircraft gives a promise of lower operating costs on a seat mile basis but the fulfilment of this promise requires high utilization which in turn requires lower fares to achieve. Thus we have a complete circle.

Future fares

The majority of the airlines agree that in order to increase the size of the market, lower fares are a necessity.

Just how it will be possible for the airlines to reduce fares and still remain solvent is the problem that needs a solution, as the cost of the ingredients of air transportation is continually rising. There is strong reaction in the USA at the present moment to obtain fare increases to help the airlines out of their financial predicament. Some tariff reductions might be possible on a promotional basis, such as off-season fare reductions, reduced fares on off-peak-load days or hours.

TCA's President, in an address to the Canadian Club of Montreal on April 8, 1957, made the statement:

> "At this time we believe that the growth in volume of business which we hope for, coupled with the improved efficiency of turbine aircraft, will continue to make fare increases unnecessary unless costs and the ingredients of the product rise more sharply than has been estimated".

TCA has also just announced that it will not ask for a jet surcharge.

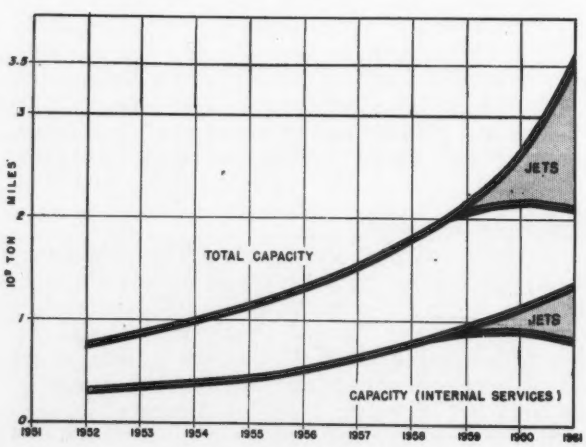

Figure 13
Projected traffic capacity of European airlines

FUTURE TRENDS

A number of trends seem to be developing in the air transportation industry, some of which show promising solutions to some of the airlines' problems, others an insight into things to come.

Market development

At the IATA traffic meeting held in Hawaii, the Director of IATA stated that if the airlines want to fill their empty seats, they will have to forget that they are in the airline business and begin operating as though they were in the travel business. As an example, further increase in European tourist business is restricted by the lack and quality of hotel accommodation. Pan American Airways are also in the hotel business in order that their passengers to foreign parts should be well taken care of.

New tourist areas

There is also a need to develop new areas for tourist travel to supplement the well-beaten paths to Europe and the Caribbean. The South Pacific, Africa and the Orient are probably the next areas to be developed for tourist trade.

The jet aircraft will certainly take the tourist wherever he wishes to go in the world, quickly and safely.

Equipment pools

Another trend in the future is the establishment of equipment pools to lessen the impact of high equipment costs. Air Union (European airlines consisting of Air France, Lufthansa, Alitalia, and Sabena) has already been formed. Initial emphasis will be placed on the co-ordination of the commercial side to be followed by rationalization of equipment and engineering. Exploratory efforts have already been undertaken to form an association of airlines flying into Africa to pool jet equipment, maintenance and operations. There are plans for organizing a British Commonwealth block. TCA has established an agreement with BOAC covering schedules and sales as a first step. Some US airlines have already organized a number of equipment interchange agreements. The President of United Air Lines foresees trunk line mergers in the USA as the result of problems from the large jet operating cost burden, which some carriers will not be able to carry, and from the high rate of available seat miles which the jets will generate. Such provisions will be even more of a necessity for the operation of the next type of aircraft, the supersonic Mach 3 jet, which may cost upwards of 20 million dollars.

Air transportation of cargo

One of the most promising and the most likely area of rapid expansion is the air cargo operation. The success of the cargo operation and the rapid increase of air cargo traffic within the airlines has forced management to look again at this poor cousin of the air passenger business. Air cargo has been recently expanding at a faster rate than the passenger side – over 15% in the US in 1959. The US airlines have been converting passenger aircraft to cargo to take care of the increase. TWA converted 8 Super Constellations and Eastern 5 to cargo last year. Pan American are converting 10 DC-7's and United 6 DC-7's to cargo. A powerful and possibly revolutionary impetus to the air cargo business will be the introduction of a modern efficient aircraft specifically designed for cargo. Such an aircraft may be Canada's Canadair CL-44. Studies are now going on in the USA to arrive at the development of a new domestic rate for air cargo, which may be as low as 6c per ton mile to the shipper. Average rates are expected to run at 13c per ton mile, as compared with the present 18c and 19c. FAA Administrator, E. R. Quesada, told Congress in February, 1960, that the CL-44 is the only existing aircraft which meets both the operational cost and performance requirement outlined by the Defense Board and FAA.

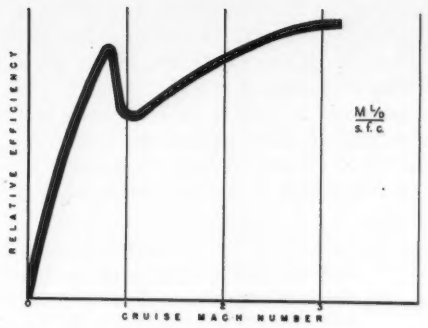

Figure 14

Supersonic aircraft—the next step

It has been proposed that airline operators should agree to slacken the rate of aircraft re-equipment and thus reduce capital requirement and overhead. This seems more desirable at this time of uncertainty as the result of the introduction of large jet fleets. This, however, would be going against the law of re-equipment, which states that any machine must be replaced by another which can perform the same service more efficiently.

There is little speed development potential in the subsonic jet aircraft (Figure 14). The existing subsonic jet, such as the DC-8 and Boeing 707, are cruising at their most efficient speed ranges at Mach 0.87. Range efficiency drops rapidly towards Mach 1 and remains in an undesirable range until Mach 1.5. At Mach 3 the efficiency is at its peak with available turbojet engines and American designers feel that the Mach 3 aircraft will be the first supersonic commercial aircraft.

There seems to be some conflict among the experts as to when a supersonic aircraft can or should be put into service. Lockheed and North American Aircraft indicate that supersonic transport aircraft can be available in 1965. TWA's President, Charles S. Thomas, feels that supersonic aircraft will be available in 1967. Robert Six, President of Continental Airlines, feels that he will be operating such aircraft in 1967. C. R. Smith, President of American Airlines, feels that supersonic aircraft are too expensive to develop without help from the government and that the USAF is showing little interest in such a project.

Donald Douglas questions the wisdom of switching from a 600 mph aircraft to one of 1800 mph when it is possible to go hypersonic at 10,000 mph within the period of our lifetime.

R. C. Seebold, Vice-President, Engineering, of Convair, has given the following interesting illustration of the benefits of such an aircraft to the airline passenger, by the following sequence of events:

New York 8.00 am EST – wife reminds husband that it is time for him to leave for the office. He replies that he has an extra half hour because his first conference is on the west coast, not in Manhattan.

New York 8.30 am EST – leaves for airport.
9.30 am EST – departs for Los Angeles on Mach 3 Supersonic Transport.
8.00 am PST – arrives in Los Angeles.
9.00 am PST – arrives at conference.

The next step beyond the supersonic jet transport will probably be the ballistic transport, but that will be our children's problem.

CONCLUSION

The air transport industry has seen a rather straightforward line of development at a rather rapid rate since its beginning. The advent of the gas turbine and the long range jet will change this normal straightforward progress. On one hand it provides a great potential. If it can be operated efficiently and fully, it will provide another major penetration into the mass transportation market and will probably be the biggest money-maker the airline industry has seen. Operated inefficiently, and with load factors lower than present levels, it could produce economic disaster. Certainly the airlines will have to cope with larger and more pressing problems than they previously have been faced with, but the airlines are massing their resources to a greater degree than even before for the solution of their problems.

The jet age will certainly offer to the travelling public many benefits. It will allow them to easily visit new places; it will give them an unprecedented standard of service, higher speed, lower internal noise and lack of vibration, better meals and, possibly, lower fares. It will materially enlarge cultural, political, economic and social horizons.

Improvements in transportation in the days of the Romans changed their world from one of feudal states to a unified empire. Air transportation will provide a powerful impetus to the same end in our age but on a global scale.

THE BY-PASS ENGINE†

by A. G. Newton*

Rolls-Royce Limited, Derby

INTRODUCTION

It now seems to be generally accepted that the basic engine for all future commercial aircraft is the by-pass engine or, as some manufacturers prefer to call it, the fan engine.

Ducted fan and by-pass engines are not new – Whittle patented the basic principles in a patent applied for in March of 1940 and granted in December 1946, and Metropolitan Vickers built and tested a fan engine before 1950.

Rolls-Royce interest in by-pass engines was generated by an Air Ministry requirement for a long-range bomber laid down in 1946, operating at high subsonic speeds and conditions which were eminently suitable for commercial jet transport operation. The first Rolls-Royce proposal – dated February, 1947 – was the BJ.80 engine of 8,000 lb and about 0.6 by-pass ratio. This developed to the original Conway engine, design of which was started in January, 1950, and which first ran in August, 1952. It was scheduled for the Vickers V.1000 military transport of 250,000 lb all-up-weight, a project which was unfortunately cancelled in 1955.

Around this by-pass type of engine a good deal of controversy has raged. Naturally, as we had commenced the development of this engine, Rolls-Royce was convinced that it had some definite, though not necessarily large, advantages in performance. Development of the Conway engine has convinced us of the reality of these advantages. The events of the last 12 months have completely vindicated our faith in this type of engine.

Our experience in the development of the Conway has led us to carry out many detailed investigations as to the performance and weight of such engines, to find the optimum conditions of by-pass ratio, turbine entry temperature, pressure ratio etc. Whilst the conclusions of such optimizations can only be as good as the basic assumptions fed into the study, they do at least ensure, provided that they are carried out carefully and honestly, that the basic configuration of a new engine project is not too far removed from the best that can be achieved. Obviously, no single engine can be the theoretical optimum for a whole range of different operational requirements and the art is in the intuitive selection of a representative mission around which to optimize. It is also apparent that certain aircraft limitations, or the thrust development of an engine, may be more easily met by departing from what would otherwise be the best engine configuration.

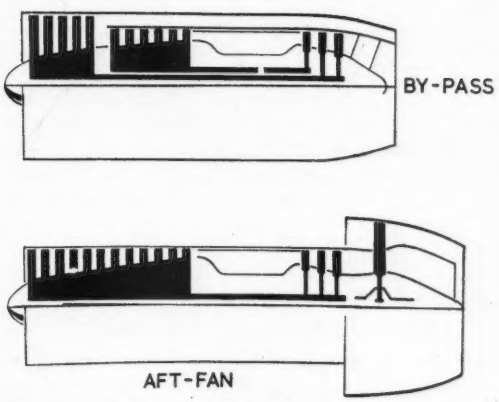

Figure 1

Figure 1 shows the two configurations diagrammatically and it is immediately obvious that, for a given frontal area, the aft fan arrangement must suffer in that either the fan tip speed must be abnormally high, with attendant losses, or the fan turbine blade speed must be low, again with a loss in component efficiency. This, together with the mechanical problem of sealing between the two streams, is the main objection to the aft fan arrangement. On the other hand, the elimination of the drive from the turbine to the front fan means that the aft fan arrangement is inherently lighter. On balance, our investigation showed that this weight reduction did not offset the inferior performance and, since we had accumulated very large experience on the Conway, the choice of front fan for the new engines was obvious. Nevertheless, the aft fan arrangement would appear to be the simplest and cheapest method of converting an existing jet engine to a by-pass type of engine.

The next part of this paper, therefore, summarizes the reasons why we have chosen the particular configurations for our newest family of by-pass engines. It may, however, be advantageous to describe the construction and method of operation of a typical modern by-pass engine with reference to the following diagrams:

Figure 2 – A single air intake takes in the whole of the engine air which is then partially compressed in a low-pressure compressor, driven by a multi-stage turbine. The air flow then divides, part of it flowing down a continuous by-pass duct whilst the other part is further compressed in a high-pressure compressor mounted on a separate shaft and driven by a high-pressure turbine.

†Paper read by Mr. S. Taylor, Chief Sales Engineer, Turbojet Engines, Rolls-Royce of Canada Limited, at a meeting of the Montreal Branch of the C.A.I. on the 17th February, 1960.

*Chief Project Engineer

This fully compressed air passes through a combustion chamber consisting of 10 tubular flame tubes situated within annular air casings and, after expansion through the turbines, is mixed with the by-pass air as it enters the jet pipe. Immediately aft of the mixing plane is an internal thrust reverser, of the type which has been developed for the Avon and Conway engines, and the whole of the gases are ejected through a common propelling nozzle.

Figure 3 – The thrust reversing device is furnished as an integral internal part of the engine, thereby ensuring reliability equal to that of the engine itself. Thrust reversal is achieved through a pair of eyelids mounted on concentric bearings on the side of the exhaust unit. In the forward thrust position these eyelids form part of the inner wall of the exhaust section and have a negligible effect on the flow of the exhaust gases. For reversing operation they swing rearwards, blanking off the rearward jet stream and uncovering the large openings in the exhaust section skin containing cascade assemblies. The exhaust gas, during reversing, flows outward through the cascade assemblies, which turn the gas approximately

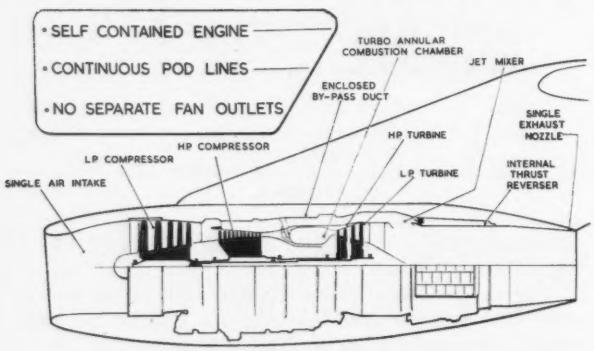

Figure 2
RB 141 powerplant layout

45 degrees forward. Reverse thrusts of the order of 50% of the corresponding forward thrust can be achieved with this system and considerable test experience has been built up to confirm the reliability of the system. Zero thrust, or low values of positive or negative thrust, can be achieved at airfield approach conditions at the high engine speeds required while bleeding air for boundary layer control by selecting an intermediate position of the reverser eyelids.

CHOICE OF ENGINE CONFIGURATION

It is not very long since it was quite common practice to compare different engines merely by looking at the performance quoted in the engine manufacturer's specification – and sometimes even the test-bed performance was used as a basis for comparison. Happily, the customer has been educated to appreciate the many different factors which must be taken account of in such a comparison.

These important parameters may be listed as follows:

(1) Thrust.
(2) Specific fuel consumption.
(3) Installed weight – this must take account of nacelle weight, intakes and exhaust systems which may not bear a direct relationship to the bare engine weight.
(4) Bulk of the engine – the effect on the aircraft per-

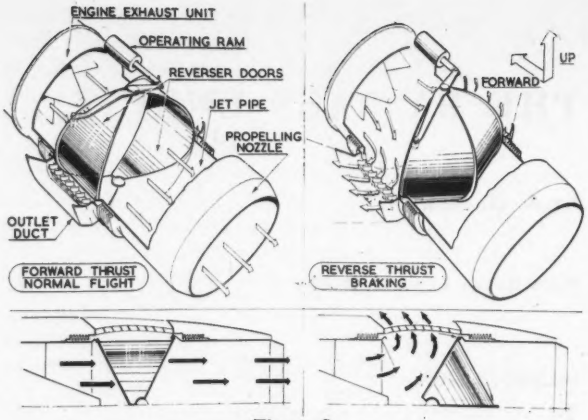

Figure 3
Diagram of thrust reverser

formation of a variation in the drag of the nacelle must be considered and possibly such features as a variation in the length of the undercarriage to maintain constant ground clearance with engines of different diameters.

(5) Engine price – this important parameter can be largely influenced by modified component design. This aspect is, however, a subject in itself, and I do not propose to dwell on it.
(6) The name of the manufacturer is one of those imponderables which cannot be neglected. It is an important quality for discussion in the boardroom as a guarantee (or otherwise) that the other specified quantities will be met in practice.
(7) Noise – Today the noise level of a civil aeroplane is of extreme importance and the predominant feature is jet noise, although, with higher by-pass ratios, we may find that intake noise becomes more troublesome. Jet noise may be reduced either by incorporating a silencing nozzle or by designing the engine to give lower jet velocities. If it is necessary to incorporate a silencing nozzle in order to achieve a required noise level then the penalties must be included in any comparison.

The manner in which these various factors influence the comparison is shown in Figure 4.

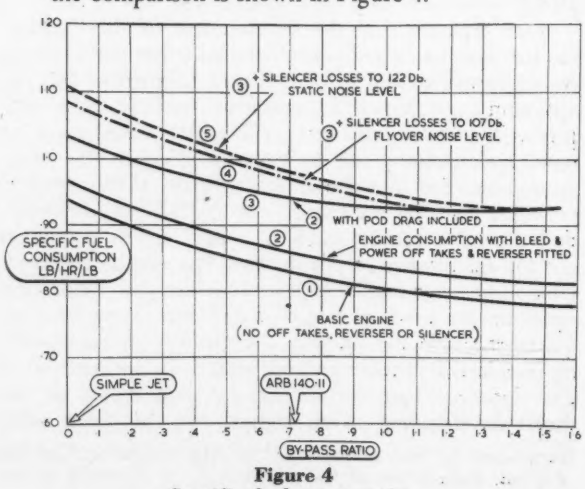

Figure 4
Specific fuel consumption
Cruise at 35,000 ft, 495 kts, ISA + 20°F

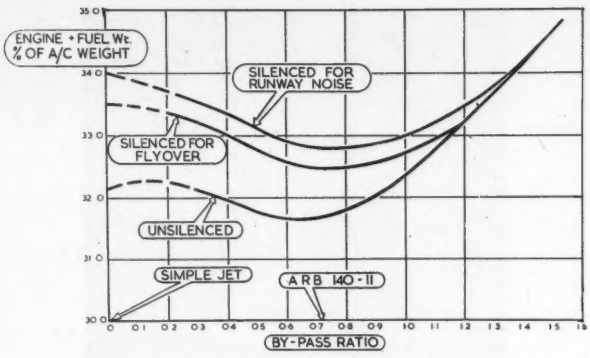

Figure 5
Engine plus fuel for 1000 nautical miles stage length

This diagram shows specific fuel consumption at a typical cruising condition plotted against by-pass ratio. The lowest curve (1) shows the performance of the basic engine (i.e. as indicated in the manufacturer's performance specification) and illustrates the continuous improvement in sfc as by-pass ratio is increased.

Curve 2 shows the effect of including the losses due to bleed and power off-take and the thrust reverser losses which increase slightly with higher by-pass ratio.

Curve 3 shows the effect of pod drag and now we see that the curve has a definite minimum at a by-pass ratio of 1.2.

Curve 4 shows the effect of including the losses associated with a typical silencer and the minimum value is now around 1.4.

This, of course, is not the complete picture – for example, engine weight has not been included. Figure 5 includes the effect of engine weight and shows the weight of engines and fuel (as a percentage of aircraft weight) required for a 1000 nautical mile stage length with typical fuel reserves. The inclusion of engine weight has had the effect of reducing the optimum by-pass ratio to about 0.7 if silencing requirements are neglected or to about 0.8 with typical noise requirements.

Figure 6 shows a similar plot except that in this case an attempt has been made to translate the physical quantities of engine and fuel weight into rather more indefinite but pertinent functions of operating costs. This leads to the same conclusion as before in the case of the unsilenced engine but would indicate an optimum by-pass ratio of about 1.05 when silenced to typical, but rather severe, requirements.

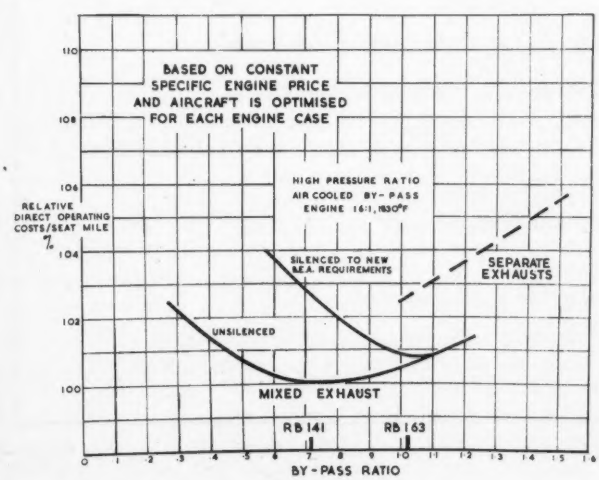

Figure 6
Operating costs

These requirements, specified by British European Airways, call for a noise level at a point on the ground 2.5 miles from the start of takeoff, which is 6 decibels quieter than both the Comet 4 and Viscount aircraft, which have established themselves as acceptable in service.

What these curves do indicate is that, for a new engine, one should not design for by-pass ratios much outside the range 0.7 to 1.1 and the actual value will depend on the specified noise requirements. It should be emphasized again that, although jet noise decreases with increasing by-pass ratio, it is more than probable that the problems of intake noise will become more severe, partly due to the increased mass flows of the engine but mainly due to the higher fan tip speeds which are apparent on certain types of fan engines.

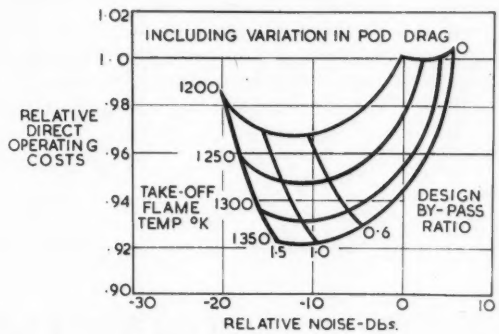

Figure 7
Short range transport
Variation of DOC and noise at climb away relative to datum values for a simple jet at 1200°K takeoff flame temperature

You will see that Figure 6 contains two curves, one labelled 'mixed exhaust', the other 'separate exhausts'. We have always upheld the philosophy that there should only be one efflux from the engine (and indeed also that the whole of the air should be taken in in a common intake). This gives the minimum of installational problems and avoids the necessity for installing more than one thrust reverser. All of our by-pass engines are, therefore, constructed with a by-pass duct carrying the by-pass air to a point rear of the turbine and directing this air into the main jet-pipe. It is apparent that, if this mixing process can be carried out efficiently, then it is possible to achieve an improvement in performance due to the increase in propulsive efficiency of one common stream compared with two streams at different velocities. To mix with low losses requires low velocities and, therefore, the total pressures of the two streams must be sensibly equal. The mixing process, therefore, to a certain extent dictates the distribution of work between the compressors. The mixing process is accelerated by the introduction of chutes to direct the by-pass air into the jet-pipe and, for a by-pass ratio of unity, a theoretical improvement of over 4% in cruise consumption is

achievable. Rig tests indicate that, in practice, the losses in the mixer can be reduced to such a level that we can expect to achieve an over-all improvement of just over 2% – a well worthwhile improvement.

The operating flame temperature of the engine is another important design parameter. Figure 7 shows the effect of both flame temperature and by-pass ratio on operating economics. It will be seen that other than for a pure jet engine, it is always advantageous to design the engine to operate at temperatures as high as are consistent with safe and reliable operation. To this end we plan to operate our new by-pass engines at temperatures which have been covered by the experience which we have gained on the Conway. In particular, we shall include the feature of air cooling of the high-pressure turbine blade on which we have accumulated a great volume of satisfactory experience. Our experience already exceeds 65,000 hours of engine running and by the time that our new engines enter service, we shall have experience amounting to nearly 3 million hours (Figure 8).

This, in fact, is one of the main lessons which we have learned in our experience of by-pass engine development – that the advantages can be increased by operating at higher flame temperatures. In turn, this has led to our development of efficient blade cooling systems and to satisfactory manufacturing techniques for air-cooled blades. This knowledge is not acquired overnight!

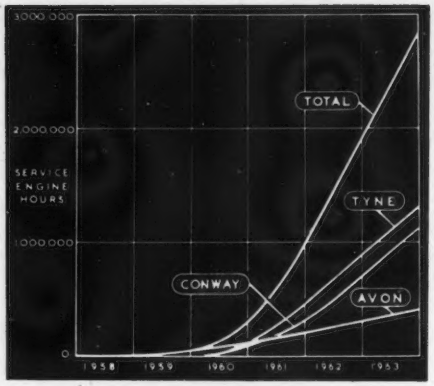

Figure 8
Rolls-Royce experience with air-cooled blades Avon, Conway and Tyne

CONCLUSION

We have attempted to explain the reasons which led to the choice of by-pass ratio for our new engines and it should be emphasized here that we had complete freedom of choice of the engine parameters – we were not restricted by limitations imposed by the use of existing components.

TECHNICAL FORUM

On an Aerodynamic Model of a Two-Dimensional Jet Adequate for Estimating the Performance of Jet-Flap Systems†

by Prof. S. Pivko

Aerotechnical Institute, Beograd-Žarkovo, Yugoslavia

In standard jet-flap theories, it is usually assumed that a jet of compressed fluid, emerging from the trailing-edge of a thin airfoil in an inviscid flow, is infinitely thin and infinitely long, having no mixing with the surrounding air flow.

In reality, the spreading of a jet releasing into a stream of air of different speed is a turbulent mixing process. During the mixing the jet entrains the external air, which must therefore have a velocity perpendicular to the virtual jet boundary. This entrainment velocity v as given by the theory and supported by experiment[1] can be shown to be satisfied very roughly by the relation

$$v = \left(\frac{\rho}{\rho_o}\right)^{\frac{1}{2}} \frac{V - V_o}{25} \tag{1}$$

where ρ, V and ρ_o, V_o are densities and velocities of jet fluid and undisturbed external air flow, respectively.

The mixing effect of the jet leads to an increase in the mass flow and to a decrease in the jet flow velocity. The law of the velocity decrease along the jet may be approximately predicted by assuming that the momentum in the jet remains constant. If the jet thickness does not exceed appreciably the exit nozzle width x/δ_1, the condition of momentum constancy leads to the following expression[2] for the velocity distribution along the jet

$$\frac{V - V_o}{V_o} = \frac{1 - \lambda}{\lambda} \cdot e^{-\frac{x\delta_1}{12.5}} \tag{2}$$

where $\lambda = V_o/V_1$ denotes the ratio of the undisturbed external air flow velocity and the jet exit velocity. The solid curve a on Figure 1 shows typical distribution of the ratio $(V - V_o)/V_o$ along the jet as calculated from Eq. (2), for $\lambda = 0.4$, in function of the relative distance x/δ_1 from the exit nozzle. When the real jet width is considered, an expression similar to Eq. (2) may be obtained. The dotted curve b on Figure 1 refers to the case when the virtual boundary of the jet widens to a wedge with a semiangle of about 5°.

According to the assumptions applied in the potential theory, the effect of a jet on the main flow around an airfoil may be to a first order compared with the similar effect due to vortex sheets distributed along the virtual jet boundaries. The local strength of these vortices, $V_o g(x)$ per unit length, may be regarded as proportional

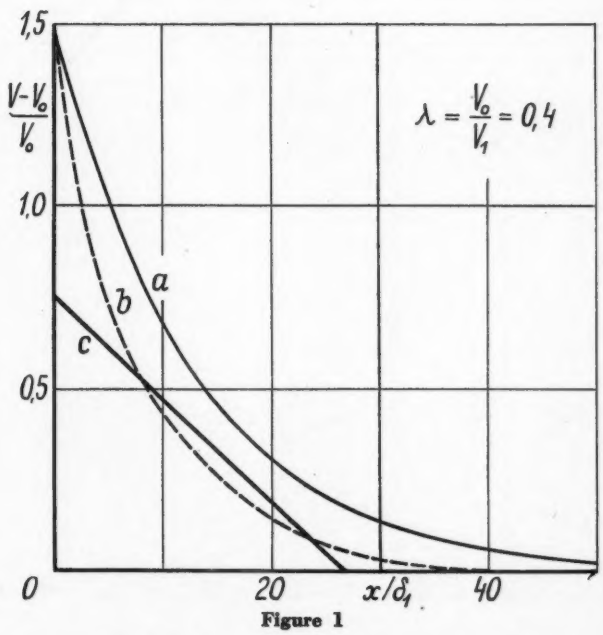

Figure 1

to the local differences of velocities $V - V_o$, V being the velocity just inside and V_o the velocity just outside the virtual jet boundary line, so that

$$V_o\, g(x) = k(V - V_o) \tag{3}$$

The factor k may be considered as a practical proportionality jet shape factor. Its value depends essentially on the angle at which the virtual jet boundary is inclined to the undisturbed external air flow, but it is affected also by the flow conditions in the airfoil trailing-edge region, by the jet flow intensity and efflux angle. For a jet emerging at a deflexion angle τ from the trailing-edge of a thin airfoil at incidence α, the value of the proportionality factor may be assumed[2] as $k \approx \alpha + \tau$.

Figure 1 shows that the value of the ratio

$$\frac{V - V_o}{V_o} = \frac{g(x)}{k} \tag{4}$$

decreases very rapidly with the distance from the exit. On the basis of numerous experimental data concerning the velocity on the jet axis, measured in most cases in jets with circular exits, it may be concluded that the measured velocity distributions near the jet exit are very

†Received 30th March, 1960.

similar to a linear decrease of velocity. According to these results, the aerodynamic effect of a jet on an airfoil would depend essentially only on a comparatively short portion of the jet near the jet exit, where the velocity distribution may be replaced by a linear distribution. The influence of the remaining portion of the jet, where the jet flow velocity has a value not appreciably exceeding that of the free stream, may be neglected. Furthermore, taking into account the unavoidable jet exit losses, which may be quite large, the calculations of the aerodynamic action of a jet on an airfoil may be done rather with the reduced value of the exit velocity V_1 than with its full value.

Thus, as a result of such a simplification of the jet geometry, in order to evaluate the aerodynamic action of a jet on airfoil properties, the real jet may be adequately replaced by a more appropriate aerodynamic model suitable to simple calculation, having a linear distribution of velocity as shown by the solid line c in Figure 1 for $\lambda = 0.4$.

When the jet is emerging at distance x_1 from the leading-edge and is blown tangentially over the upper surface of an airfoil or flap, the linear velocity distribution along the jet is determined by

$$\frac{V - V_o}{V_o} = \frac{g(x)}{k} = \frac{g_1}{k} - \frac{g_2}{k}(x - x_1) = \frac{g_2}{k}(x_1 + s - x) \qquad (5)$$

where the distances x, x_1 and the jet length $s = g_1/g_2$ are expressed as fractions of airfoil chord. Experimental results suggest the following semi-empirical relations[2] for g_1/k and g_2/k:

$$\frac{g_1}{k} = \frac{1 - \lambda}{2\lambda} \qquad (6)$$

$$\frac{g_2}{k} = \frac{1 - \lambda}{\lambda} \cdot \frac{1 - (2 - \lambda)\lambda^2}{20\,\lambda^2 c_J} \qquad (7)$$

where

$$c_J = \frac{J}{\frac{1}{2}\rho_o V_o^2} \qquad (8)$$

is jet-momentum coefficient, with J flux of momentum.

The velocity at any point of the airfoil is the resultant of the free-stream velocity V_o and the velocities induced by the vortex distributions $V_o f(x)$ and $V_o g(x)$, representing airfoil and jet sheet, respectively. When assuming that the main flow around the airfoil does not influence the velocity distribution in the jet, the approximate aerodynamic properties of the airfoil influenced by the jet can readily be determined.

Figure 2 shows the comparison between the lift coefficient C_L, as calculated in such a manner (dotted lines), and experimental results[3], obtained with a two-dimensional airfoil having a 12.5% thick elliptical cross section with a narrow full span jet slot at the trailing-edge, the jet deflexion being $\tau = 31.4°$. The thin lines shown for comparison are those given by the theory of Spence[4]. It is shown that the values obtained experimentally agree satisfactorily with those suggested by the semi-empirical theory. It is believed, therefore, that this agreement is sufficiently close to justify the use of the proposed aerodynamic model of a two-dimensional jet for estimating the performance of the usual jet-flap schemes.

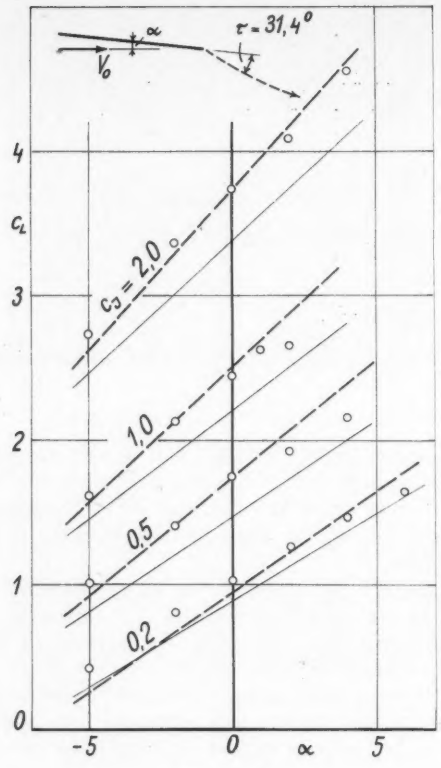

Figure 2

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Analogies Between the Buckling and Vibration of Polygonal Plates and Membranes†

by Prof. H. D. Conway*

Cornell University

SUMMARY

The following article shows that the eigenvalue problems of the buckling of a simply-supported polygonal plate under two-dimensional hydrostatic stress in its plane, and the vibrations of the plate and corresponding membrane are all identical.

Examples are given of the rectangular and equilateral-triangle plates and membranes.

ANALYSIS

Consider first a thin plate of constant thickness h subjected to two-dimensional hydrostatic compression P per unit length in its plane. For buckling, the differential equation is

$$D\nabla^4 w + P\nabla^2 w = \nabla^2(D\nabla^2 + P)w = 0 \tag{1}$$

with the usual plate notation, the boundary conditions for a simply-supported polygon being

$$w = \nabla^2 w = 0 \tag{2}$$

Thus, ignoring the trivial solution, the buckling of the plate is governed by the second-order equation

$$D\nabla^2 w + Pw = 0 \tag{3}$$

Consider next the vibration of a polygonal membrane with constant tension S. The differential equation here is

$$S\nabla^2 w - \rho h \partial^2 w/\partial t^2 = 0 \tag{4}$$

where ρ is the density and t is time. Writing $w = w_0 e^{ipt}$, this becomes

$$S\nabla^2 w + \rho h p^2 w = 0 \tag{5}$$

where, as before, the boundary conditions are

$$w = \nabla^2 w = 0 \tag{6}$$

Comparing Eqs. (3) and (2) with Eqs. (5) and (6), respectively, it is seen that the two problems are analogous. Thus, when the buckling loads of the plate are known so also are the frequencies of the membrane, the corresponding modes being the same in each case.

Consider finally the vibration of a thin, simply-supported polygonal plate. The differential equation is

$$D\nabla^4 w + \rho h \partial^2 w/\partial t^2 = 0 \tag{7}$$

Substituting $w = w_0 e^{ipt}$, this becomes

$$(\nabla^4 - k^4)w = (\nabla^2 + k^2)(\nabla^2 - k^2)w = 0;\ k^4 = \rho h p^2/D \tag{8}$$

The equation $(\nabla^2 - k^2)w = 0$ produces imaginary frequencies, and thus the vibration of the plate is governed by

$$(\nabla^2 + k^2)w = 0;\ k^4 = \rho h p^2/D \tag{9}$$

the boundary conditions again being

$$w = \nabla^2 w = 0 \tag{10}$$

It follows that this problem is also analogous to the previous two. Other analogies outside the field of aeronautical engineering also exist.

Examples

For a long simply-supported rectangular plate, the shorter side being of length a, the circular frequency of free flexural vibrations is well known to be

$$p = (n\pi)^2 (D/\rho h a^4)^{1/2} \tag{11}$$

where n are integers corresponding to the particular modes of vibration. Comparing Eqs. (9) and (3), it follows that the buckling loads are given by

$$P = n^2\pi^2 D/a^2 \tag{12}$$

Of course, the plate does not have to be long for the analogy to exist, but the above is a novel derivation of Euler's buckling formula. The frequencies of the corresponding membrane are obtained similarly.

Consider next the vibration of an equilateral-triangle membrane, the fundamental frequency $p/2\pi$ according to Lord Rayleigh[1] being

$$p/2\pi = (S/\rho h a^2)^{1/2} \tag{13}$$

where a is the altitude of the triangle. Thus, by analogy, the buckling load of the simply-supported equilateral-triangle plate under two-dimensional hydrostatic compression is

$$P = \rho h p^2 D/S = 4\pi^2 D/a^2 \tag{14}$$

This result has been found in a different manner by Woinowsky-Kreiger[2].

Finally, for the fundamental frequency of flexural vibration of a simply-supported equilateral-triangle plate

$$\rho h p^2/D = 16\pi^4/a^4$$

or

$$p/2\pi = (2\pi/a^2)(D/\rho h)^{1/2} \tag{15}$$

ACKNOWLEDGMENT

Several profitable discussions with the staff of the National Aeronautical Establishment are gratefully acknowledged.

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(2) Timoshenko, S. – *Theory of Elastic Stability*, McGraw-Hill Book Co., New York, p 371, 1936.

†Received 19th August, 1960.

*Professor of Mechanics. Consultant, National Aeronautical Establishment.

C.A.I. LOG

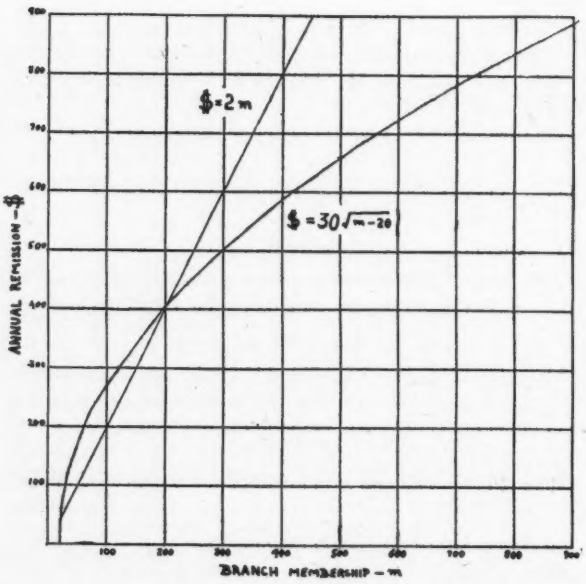
SECRETARY'S LETTER

BACK AGAIN

THIS is the first issue after our two-months summer recess. I hope that all our members – in fact all our readers – have had good holidays, even though they have had to make do with more frivolous reading!

The new Executive Committees of the Branches and Sections have been busy planning programmes for the coming season. The Astronautics Section has completed its plans for a two-day Symposium in Ottawa in October; the Test Pilots Section has made good progress with plans for another two-day Symposium, to be held in Halifax-Dartmouth in November; most of the Branches have their pre-Christmas programmes mapped out; and even the newly-formed Man-powered Flight Committee has laid out a series of articles, which I hope will appear in the forthcoming issues of the Journal.

All this has entailed work. The very least that our members can do in return is to resolve to make a special effort this season to turn out to meetings. The Annual General Meeting, held last May, was a good meeting spoiled by a very poor attendance.



BRANCH FINANCING

To the Branches September is a critical month for the payment of members' dues, because a Branch's income depends on the number of its members in good standing on the 1st October. So those who have not yet paid their dues for 1960-61 are urged to do so at once, for their Branches' sake if not for their own. (They themselves will fall into arrears after the 1st October and will then be deprived of the privileges of membership.)

A new formula for the financing of Branches is being introduced this year. In the past a Branch received, roughly, $2 for each member. This was not satisfactory, in that the smaller Branches had a job to make both ends meet, while the bigger Branches built up their bank balances to unreasonable proportions. The new formula is devised to distribute the funds more realistically in accordance with the Branches' needs, without materially altering the total amount devoted by the Institute to Branch activities. The new formula is parabolic; a Branch will receive $\$30\sqrt{m-20}$, where m is the number of its members in good standing. But payment is made in two instalments and the Branch stands to lose heavily on those members who have not paid their dues by the time the first instalment is paid.

MEMBERSHIP CARDS

Reverting to the privileges of membership, one of these is the right to attend Institute Meetings without payment of registration fee. When a member has paid his dues, he is sent a Membership Card for the current year to show that he is a member in good standing. These Cards are not supplied to encumber people's wallets; members claiming exemption from payment of registration fees must be prepared to produce their Cards when necessary to substantiate their right to the claim.

GRADING

While working on the *List of Members* which was issued recently, I was surprised to note the grading of

some of our long-standing members; I am sure that a great many would now qualify for higher grades than those to which they were admitted in 1954 or so. Bearing in mind Mr. Wood's comments on page 243 on the subject of CAI grading, I suggest that anyone who thinks that he now qualifies for advancement in grade ought to apply. There is a form for the purpose obtainable from Branch Secretaries or from this Headquarters.

BYLAWS AND REGULATIONS

The booklet of the Bylaws and Regulations has now been re-issued, including the amendments adopted last December. Copies will not be distributed to all members but are available on request.

FILMS

In collaboration with the Air Industries and Transport Association and the Canadian Owners and Pilots Association, the Institute is working on a revision of the *Canadian List of Aviation Films*, which first appeared in 1958. We have asked a good many companies to let us list their more recent films and several have been most co-operative. I hope that in the coming months all our members will help, by letting us know of any list-worthy films they may see.

To list a film we must have specific details about it and we have prepared a special Check Sheet, setting out what these details are. These Check Sheets can be obtained from Branch Secretaries or from this Headquarters. Information given to us by letter, or even in the little folders used by so many film-holding companies, usually omits some detail that we want to know and is, consequently, of no value to us. So please use the Check Sheets.

We plan to publish particulars of new (i.e. 1960) films in the Journal, as and when we hear of them, in advance of the issue of the Film List. Later on we shall gather them together and, with particulars of some rather older films, they will form the main body of the List itself. And we hope that it will be possible to reissue the List annually, to bring it up to date and prune out some of the dead wood.

A concise, categorized and up to date list of films would be a great boon, not only to our own Branches but to all manner of groups, clubs, schools etc that like to hold film showings now and then. With the AITA and COPA we have a real responsibility to the Canadian public to see that such a list is available.

AD ASTRA

Our distinguished progenitorial society, the Institute of the Aeronautical Sciences, has changed its name to the Institute of the Aerospace Sciences. I suppose we shall have to get used to it and I hope that we shall be forgiven if we slip back inadvertently to the old name from time to time.

The reasons for the change are obvious enough and doubtless the IAS was wise, in its own circumstances, in being swayed by them. But, personally, I think it is a pity to change a proud and honoured name simply because people are liable to think that it means what it doesn't. There is ample precedent of guilds, societies and even unions expanding their scope by natural steps in the course of evolution, without changing their names. Surely, by their fruits ye shall know them; and surely everyone knows the fruits of the IAS.

ANNUAL GENERAL MEETING

THE Seventh Annual General Meeting of the Institute was held in the Chateau Laurier, Ottawa, on the 24th and 25th May, 1960. The programme opened with the Business Session and included the Annual General Meetings of the three Specialist Sections, three technical sessions and the Honours and Awards Session; the Annual Dinner took place in the evening of the first day. Total registration was 185; on the whole a rather disappointing attendance for so good a programme.

BUSINESS SESSIONS

Of the Institute

Mr. G. D. Watson, Vice Chairman of the Ottawa Branch, welcomed the members to the Meeting before turning the opening session over to the President, Dr. D. C. MacPhail. After outlining the order of business, the President called on the Chairman of the various Institute Committees to present their Reports; all the Chairmen were present in person, with the exception of A/C W. P. Gouin, Chairman of the National Programmes Committee, whose Report was read to the Meeting by G/C D. M. Holman. The Reports are published in full elsewhere in this issue and there is no need to dwell upon them here, though it is worth commenting on the Report of the Finance Committee and its observations on the state of the Institute's finances. Mr. D. Boyd, the Chairman of the Committee, pointed out that, for the first time, the Institute had sustained a loss on the year's operations – a loss of some $4011 – and that the prospects for the coming year were not promising, unless

Mr. G. D. Watson, Vice-Chairman of the Ottawa Branch, welcoming the members to the meeting.

means could be found of increasing the Institute's income; any economies further to those already effected after the cancellation of the Arrow were impossible without a material sacrifice of the Institute's services. However he stressed that the situation, though grave, was not critical; there was no cause for panic or alarm.

The President, in presenting the Annual Report of the Council, touched on the highlights of the full Report, as published on pages 275 to 279. He too referred to the financial situation and spoke at some length on the negotiations which had been going on between the Executive Committee and the Canadian Astronautical Society with a view to some form of merger; to date these negotiations had been unsuccessful but they were continuing. He concluded by announcing the names of those elected to Fellowship and introducing the incoming Council.

There were only 51 members present, barely a quorum, and there was no discussion of any of the Reports.

Of the Astronautics Section

The Annual General Meeting of the Astronautics Section was held in the morning of the 24th May, with Mr. D. Bogdanoff in the Chair. Mr. Bogdanoff had some solid progress to report and it was gratifying to learn of the advances in the development of the Section that had taken place during the year. A good deal of benefit had undoubtedly been derived from the fact that the Chairman and the Vice-Chairman, Dr. H. J. Luckert, had lived in the same city and had been able to meet fairly frequently to discuss the Section's business. The Section had taken advantage of this lesson and had elected its entire Executive Commtitee for the coming year from among its members living in Ottawa – Dr. P. M. Millman, Chairman, Professor G. S. Glinski, Vice-Chairman, and Mr. J. G. LaBerge, Secretary-Treasurer.

Dr. Luckert spoke on some of the developments which had taken place in the Montreal Group, notably the introduction of Discussion Evenings, Newsletters and the Astronautics Notes. Mr. H. C. Luttman, Secretary of the Institute, then discussed a few points of Section ad-

Astronautics Section: (l to r) Dr. D. G. Gould, retiring Secretary, Dr. P. M. Millman, incoming Chairman, Mr. D. Bogdanoff, retiring Chairman, Prof. G. S. Glinski, incoming Vice-Chairman, Dr. H. J. Luckert, retiring Vice-Chairman, and Mr. J. G. LaBerge, incoming Secretary.

Propulsion Section: (l to r) W/C H. J. M. Londeau, incoming Secretary, Mr. F. H. Keast, retiring Chairman, Dr. E. P. Cockshutt, retiring Treasurer, and Mr. E. L. Davies, retiring Secretary and incoming Vice-Chairman.

Annual Meeting of the Test Pilots Section

ministration and reported on the negotiations which had been going on between the Executive Committee of the Institute and the Canadian Astronautical Society, a point of great interest to the Section, though of such far-reaching significance that it had been handled so far at Institute level. A merger of all astronautical interests in Canada was obviously desirable but, to date, negotiations had invariably broken down on the question of membership qualifications. The Institute insisted on maintaining a voting membership confined to those professionally associated with the engineering and technical problems, whereas the CAS was prepared to admit anyone who could contribute to much broader aspects of extraterrestrial existence. The difficulties of reconciling these views had been emphasized by a reported merger of the CAS and the ASC (the Astronautical Society of Canada), since the membership of the latter was even less restricted to those scientifically and technically qualified. Mr. E. Wall, a member of the CAS replied to Mr. Luttman's comments with the very heartening news that the CAS and ASC had not, in fact, merged; this information was welcome, since the reported merger had seemed to compound the difficulties of a satisfactory settlement.

Dr. Millman, the incoming Chairman, took over the closing stages of the Meeting. In a short address he upheld the stand that membership of the Institute should have some professional significance in the engineering phases of astronautics; he expressed the view that the Royal Astronomical Society of Canada and the Canadian Aeronautical Institute together covered all that was needed and that these smaller and more general societies could not be justified in the scheme of things.

Of the Propulsion Section

The Propulsion Section held its Annual General Meeting immediately following the Meeting of the Astronautics Section. Mr. F. H. Keast was in the Chair. Like the Astronautics Section, it too had elected an Executive Committee for the coming year with all its members situated in one city – in this case Montreal – and Mr. Keast announced the names as follows: Chairman, Mr. J. J. Eden, Vice-Chairman, Mr. E. L. Davies, Secretary, W/C H. J. M. Londeau, and Treasurer, Mr. K. H. Sullivan.

The Section had had a very inactive year, due in part to the scattering of many of its members after the cancellation of the Iroquois project and in part to the difficulties experienced in arranging meetings of its Executive Committee. Unfortunately Mr. Eden was not present, so that it was not possible to discuss any detailed plans for the coming season but it was confidently expected that the Section's contributions both to Institute and Branch programmes would be more effective than in the past.

Of the Test Pilots Section

The Test Pilots Section met in the afternoon of the 24th May, under the Chairmanship of S/L G. H. Knight, the Section's retiring Secretary-Treasurer. He ran through the minutes of the Annual General Meeting of 1959 and reviewed the progress made in each item; some very interesting and lively discussion ensued.

With regard to the relations between the Section and the Society of Experimental Test Pilots, it was agreed that everything should be done to foster close association and cooperation, though any sort of formal affiliation was recognized to be both impractical and undesirable. S/L Knight reported on a plan which had been developed by the Executive Committee, for the provision of SETP publications to members of the Section. The matter had been discussed with the SETP, and S/L Philp, the Section's Chairman, had then asked Mr. Luttman to make representation to the Council for some financial assistance. As a result, the Council had authorized a grant of $75, over and above the $25 normally due to the Section, to be applied to paying half of the subscription to the SETP Newsletter and Quarterly, for those members of the Section who were willing to pay the other half themselves.

The technical programme of the Section was discussed. Mr. Luttman, who was present, said that the IAS had been asked to invite Mr. Scott Crossfield to give a paper at the IAS/CAI Meeting in the fall but that it would not be possible to devote a whole session of that Meeting to test flying. Mr. McLean made a plea for the resumption of Test Pilots Symposia, similar to that held in March 1956, just before the Section was formed. This suggestion was generally welcomed. Mr. Luttman pointed out that the organization of symposia was originally envisaged as one of the main functions of Specialist Sections. Such symposia were much more readily fitted into the Institute's main programme than specialist sessions at Institute Meetings and he

The transfer of the President's Chain of Office: (l to r) Mr. F. T. Wood, Principal Speaker, Dr. D. C. MacPhail, retiring President, Mr. D. Boyd, new President, and the Hon. J. A. D. McCurdy.

cited the Canadian High Altitude Research Symposium that the Astronautics Section was planning to hold in October. He offered every assistance from Headquarters in respect of notices and other services and physical arrangements. It was decided therefore to investigate the possibilities of holding a Symposium on HMCS Bonaventure on or about the 15th September and CDR W. H. Fearon undertook to make preliminary enquiries.

The incoming Executive Committee of the Section was announced as Captain R. J. Baker, Chairman, Mr. G. T. McLean, Vice-Chairman, and Mr. R. M. Kidd, Secretary-Treasurer.

HONOURS AND AWARDS

The Institute's honours and awards were announced at a special session held in the afternoon of the first day of the Meeting. As is customary the W. Rupert Turnbull Lecture was delivered at this time. A full account of the session appears on pages 272 to 274, but, in summary, the awards were as follows:

Honorary Fellow
Dr. Theodore von Kármán

McCurdy Award
Mr. C. A. Grinyer

F. W. (Casey) Baldwin Award
Mr. J. C. Vrana

W. Rupert Turnbull Lecture
Mr. A. E. Raymond

Most unfortunately Mr. Raymond was unable to deliver his Lecture in person and it was presented for him by Mr. J. B. Edwards of the Douglas Aircraft Company.

DINNER

The Annual Dinner, in the evening of the 24th May, was attended by 310 members and guests. The Head Table included, as usual on these occasions, the incoming Council, Chairman of the technical sessions, winners of awards, Mr. McCurdy and the Principal Speaker, Mr. F. T. Wood.

After introducing the Head Table, the President read an exchange of greetings that had passed between himself and the Institute's Patron, His Royal Highness, the Prince Philip. He had sent the following cable:

"The Canadian Aeronautical Institute will hold its Annual General Meeting in Ottawa on the 24th and 25th May, with the Annual Dinner on the 24th. The luncheon in Toronto last June when Your Royal Highness addressed the engineering societies of Canada gave special significance to the year that has passed and we recall with great pleasure your interest in the Institute and in our celebration of 1959 as the fiftieth anniversary of flight in Canada. We also deeply appreciated your message in October on the occasion of the Institute's first participation in the Anglo-American Aeronautical Conference. It is my honour, on behalf of the Council and members, to send greetings to Your Royal Highness, as our most distinguished Patron, and to express the hope that it will not be long before you visit us again.

D. C. MacPhail
President"

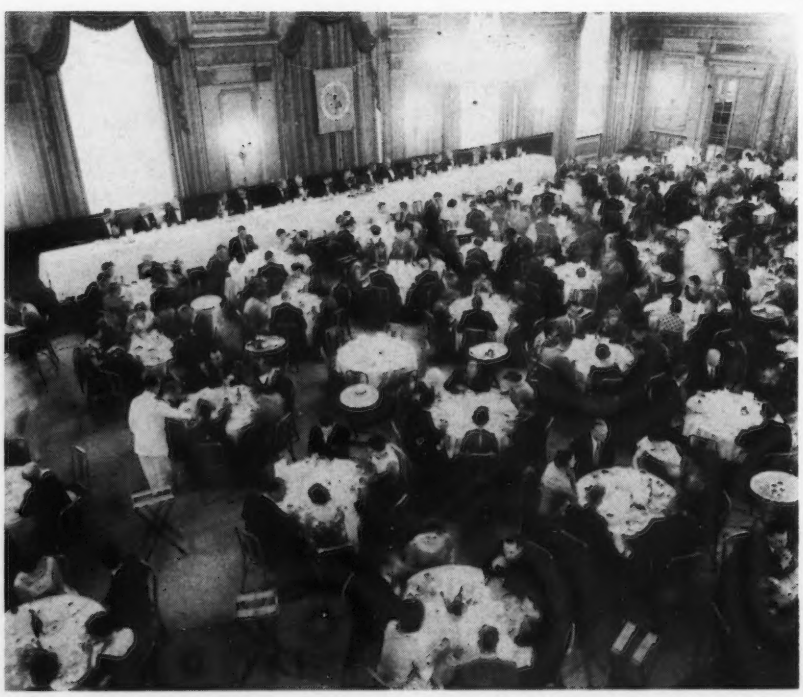
The following had been received in reply:

"Thank you very much for your kind message. I hope the fiftieth anniversary celebrations were a great and enjoyable success. Please give my best wishes to the Council and members of the Institute for the Annual General Meeting and associated festivities. May the Institute and the Industry flourish.

Philip
Patron"

His Royal Highness' reference to the Industry was most appropriate, since this was the first occasion on which the Principal Speaker, as President of the Air Industries and Transport Association, had so directly represented the Industry at an Institute gathering.

In a short address the President expressed his thanks to his colleagues on the Council and to the Secretary. He re-



Man in Space Session: (l to r) W/C R. A. Stubbs, Dr. M. G. Whillans (Chairman) and Mr. K. J. Radford.

ferred particularly to the tour of the western Branches that he had made in January, saying that it was a most stimulating experience for any President to enjoy; the spirit and resourcefulness that he found at every Branch had impressed him immensely.

Mr. F. T. Wood, President of the A.I.T.A. gave an address which reviewed the condition of the Industry, both manufacturing and airline, its history and present condition, its aims and aspirations and its attitude towards the Institute and its work. In moving a vote of thanks Mr. G. F. W. McCaffrey made special mention to Mr. Wood's comments on the absolute importance of research and development; on this point in particular the Industry and the Institute are in complete agreement and it was encouraging to hear this statement of the Industry's views. The full text of Mr. Wood's address is printed at the front of this issue.

The concluding ceremony was short and sweet. The President introduced his successor, Mr. David Boyd, and deftly transferred the President's Badge from his own shoulders to Mr. Boyd's. Mr. Boyd beamed his approval of the applause, struck the table with the gavel, announced "I declare the Seventh Annual Dinner adjourned"—and that was that.

TECHNICAL SESSIONS

Members of the Ottawa Branch have reported on the three technical sessions as follows:

Morning Session, 24th May

MAN IN SPACE

Reported by Dr. D. A. MacLulich

The session on "Man in Space" being of highly topical interest was well attended as 78 persons were present. The Chairman, Dr. M. G. Whillans, Assistant Chief Scientist (Biosciences) of the Defence Research Board, had the satisfaction of presiding over two excellent papers each followed by a lively and extended question and discussion period.

The first speaker, Mr. K. J. Radford, has had experience in operations research for the then Ministry of Supply in the United Kingdom and more recently for the Defence Research Board and is presently Director of System Evaluation in the Royal Canadian Air Force. In his paper on future uses of space vehicles, he focussed attention on important uses of space vehicles and put sensational developments into proper perspective. Military armed satellites would take as much energy to get the warhead down as to get it up and both quantities are greater than that required to fire a ballistic missile. The speaker said we cannot predict now any military offensive role for man in space but this must be constantly reviewed. Mr. Radford put emphasis on the effects of space vehicles on everyday life, for instance there should be an economical trans-Atlantic communication system based on satellites by 1964, a navigation system within two years and benefits to meteorology are already accruing. Space will be explored scientifically because it is there said the speaker.

The questions touched on the subjects of reliability, economics, countermeasures, deterrent military satellites, defence against satellite and ballistic missile attack, and the large effects of the missile industry on human welfare in the future.

The second paper, entitled "Some Engineering Considerations of the Manned Space Vehicle," was given by Wing Commander R. A. Stubbs. He served two years at the Institute of Aviation Medicine at Farnborough, England, and after transfer to the Royal Canadian Air Force became Officer Commanding, Flying Personnel Medical Establishment at the Institute of Aviation Medicine in Toronto.

The speaker dealt with requirements for the cabin environment of a space vehicle and various ways and means of meeting these requirements.

The question period explored the matter of food, including discussions of partially and completely closed systems. The difficulties that would be caused if tumbling should occur were analyzed. Disorientation could arise from insufficient information input to the space crew aggravated by weightlessness. The need for further study of man and his brain was emphasized as being essential in the penetration and occupation of the severe and lonely space environment. The opportunities of work in space are a stimulus to biology, the investigation of the origin of life and to physiological research.

Morning Session, May 25th

AIR TRANSPORTATION AND THE CANADIAN NORTH

Reported by A. S. Jackson

There was quite a good turnout on the morning of May 25th to hear the excellent papers given on subjects pertaining to Air Transportation and the Canadian North. Representatives from such Government departments as the Air Transport Board and the Air Services Branch of the Department of Transport, National Defence and Defence Production, as well as representatives from the manufacturing and air carrier industries, were among those present.

The Chairman for this rather important session was Mr. R. B. McIntyre of De Havilland Aircraft of Canada Limited and the success of the morning that was devoted to the topic can be measured not only by the excellent papers that were given but also by the considerable discussion that occurred during the question and answer period.

Air Transportation and the Canadian North Session: Mr. T. A. Harwood (l) and Dr. S. Orvig. Unfortunately Mr. R. B. McIntyre (Chairman) and Mr. E. H. Higgins missed this group.

Mr. E. H. Higgins, Chief Engineer, Aircraft, Canadair Limited, gave a most interesting paper on "Modern Cargo Aircraft Design". Rather than attempt to cover the extensive range of cargo aircraft design considerations, the speaker selected "Cargo Density" and "Cargo Handling" as being two factors that have particular significance to both the cargo aircraft designer and the operator. In so far as cargo density is concerned, Mr. Higgins pointed out that such factors as route characteristics, airline tariff structures and competitive transportation rates have a strong influence on the density of cargo offered. Moreover, such important aspects as the calculation of cargo density with its variations must also be considered in the profitability or otherwise of operating cargo services.

Mr. Higgins then went on to speak of the mechanization of cargo handling and its effects on operating costs and operating revenues. In these days of having to analyze profit and loss statements with the utmost care, it is most interesting to note the considerable degree of research that is being undertaken in endeavouring to reduce turn-around time. The speaker outlined the programme that was being undertaken at Canadair in regard to the use of light weight flexible pallets riding on rubbing strips instead of rollers and with these pallets being pulled in to or out of the main compartment by a chain drive running along each side of the floor. It was interesting to learn that this concept has been accepted by three of Canadair's commercial customers for the CL-44. Mr. Higgins also touched on the basic concept of the swing-tail arrangement on the commercial CL-44 and it was interesting to hear that such an idea had been considered at least 38 years ago in England. Finally, using a number of arbitrary assumptions, the speaker concluded by providing the gathering with a glimpse into the potential profit that is apparent from a fleet of mechanized aircraft as opposed to aircraft that are equipped for piece-loading methods only.

The second paper under this over-all topic of Air Transportation and the Canadian North was given by Mr. T. A. Harwood of Canada's Defence Research Board and entitled "Logistic Problems in the High Arctic with Reference to Air Operations".

Considerable interest was shown in this particular paper, not only because of an excellent opportunity to hear what has been accomplished up to now in regard to early exploration in the Arctic but also because of the opportunity to secure an indication of the problems that are still to be met when coupled with the development programmes that are envisaged over the next few years.

Mr. Harwood pointed out that as a means of setting up a sound structure for the present-day developments, the US Weather Bureau and the Canadian Meteorological Service installed the first of the Joint Arctic Weather Stations at Resolute Bay in 1946. The network of satellite stations was later extended to Mould Bay, Isachsen, Eureka and Alert. This new method of development and exploration was dependent entirely on suitable icebreakers and such aircraft as the C-54, both of which were available after World War II. Naturally, the development of airstrips and the lessons successfully learned and applied in the setting up and resupply of these first stations permitted the development of new and larger centres at Fox (Hall Lake), Thule, Cambridge Bay, Cape Parry and others.

The audience found it particularly interesting to hear that for any operation under present day conditions in the Arctic, there is always a fairly complex logistic problem made up essentially of (a) Transport (sea, land and air), (b) Planning, (c) Climate and Meteorology, and (d) Man. Some of these items were explained in some detail and those present found it most interesting to find out what some of these problems are. Particular interest was shown in the fact that many of these problems in the logistic field require close examination many months ahead of the actual operations.

Dr. S. Orvig, Associate Professor of Meteorology at McGill University, concluded the morning's activities with an interesting paper on "Recent Research in Arctic Meteorology". The speaker began by giving a brief outline of the history of meteorology stretching back over two thousand years.

In so far as the Arctic is concerned in particular, Dr. Orvig mentioned that the first indication about surface climatology and the lowest layers of the atmosphere formed part of the results of the first Polar Year in 1882-83 and successive expeditions have brought out more of the facts relating to Arctic meteorology. It was also pointed out that aviation had given meteorology its greatest opportunity to advance through having aided in the establishment of

Industrial Session: (l to r) Mr. T. A. Harvie, Mr. C. I. Soucy, Mr. P. W. Larsen (Chairman) and Mr. D. R. Taylor.

camps in the north, as well as in many other ways.

Dr. Orvig then spoke of the development of observational programmes in the Arctic together with the continuing research into arctic geophysics. In also speaking of the importance of research to northern sea and air transportation, he gave some interesting examples of where important facts have been learned not only by actual observation and work in the field, but also by intelligent analysis of observations from stations which have the necessary long records.

The speaker also mentioned his own personal belief that the flying boat still has a useful role to play in expeditions to the Arctic in summer and he spoke of the considerable use that has been made of Canso and Sunderland aircraft by both Canadian and British expeditions.

In concluding his paper, Dr. Orvig pointed out the importance of sound planning required for the various types of operations in the Arctic from the meteorological point of view. Study of existing published weather data and air reconnaissances have been used but in many areas a considerable amount of study still remains and a continuation of the exploration of the Arctic is therefore highly desirable for many years to come.

Afternoon Session, May 25th

INDUSTRIAL

Reported by R. T. D. Graham

Mr. C. I. Soucy, Chief Telecommunications, Air Materiel Command, RCAF, presented a very interesting paper on "Reliability/Maintainability Engineering of Aircraft, Weapons and Electronic Support Systems". This paper was a follow-on to the previous paper submitted in 1957, to show the present state of the art, and to attempt to measure how close we are to achieving our goals. As equipment and weapons become more complex, the probability of failure increases. For instance, if an objective is established to design a system 80% effective, and each component going into that system is 99.99% reliable (one reject in 1000), then the number of parts that can go to make up the system cannot exceed 110. The size of this problem can best be illustrated with the Nike Hercules missile which has 1.5 million parts, including 3,000 tubes.

Mr. D. R. Taylor, Vice-President, Aviation Electric, presented a most interesting paper on "Short Run Production". Mr. Taylor presented this problem through the eyes of Management relating the various considerations of costs, delivery, learning curve, diversification, purchasing, duty, tooling etc. He emphasized that in the defence industry, Canadian firms were frequently called upon to produce equipment which had already been designed and produced outside Canada in much larger quantities than were eventually required in Canada. The need for specialists in both engineering and manufacturing, and the constant requirement to adapt general purpose tooling to specific products was put forward in such a manner to emphasize the ingenuity required of Canadian industry. This was a most worthwhile paper, covering a subject not normally considered in paper form by the various technical sections.

Mr. T. A. Harvie, Assistant Chief Engineer, Canadair, presented a paper on "Engineers and Management". He described the functions and attitudes required of engineers and also of managers which shows that there is conflict in many areas between these two groups. By intelligent consideration of these various factors, management is always striving to integrate the engineers into the successful corporate entity.

Mr. P. W. Larson, Ottawa representative, A. V. Roe Canada Ltd., chaired this meeting of the Industrial Session. Approximately 45 members and guests attended the session, and Mr. Larson stated that it was felt that this innovation of technical papers in the Industrial field was most worthwhile indeed.

(All photos by Dominion Wide)

HONOURS AND AWARDS

THE Institute's honours and awards were presented at a session of the Annual General Meeting on the 24th May 1960, in the Convention Hall of the Chateau Laurier, Ottawa. The President, Dr. D. C. MacPhail, was in the Chair, accompanied on the platform by Air Commodore the Honourable J. A. D. McCurdy and Mr. H. C. Luttman, Secretary of the Institute.

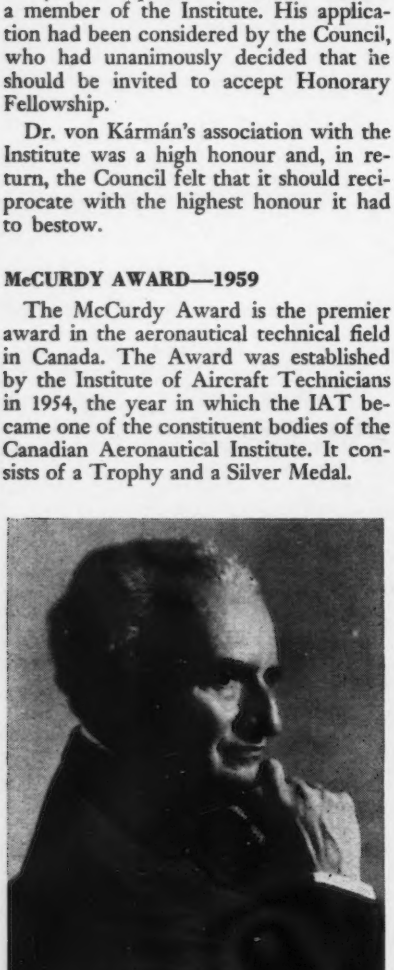
HONORARY FELLOW

The President announced that quite recently, Dr. Theodore von Kármán, Chairman of AGARD and probably the most eminent aeronautical scientist alive today, had expressed a wish to become a member of the Institute. His application had been considered by the Council, who had unanimously decided that he should be invited to accept Honorary Fellowship.

Dr. von Kármán's association with the Institute was a high honour and, in return, the Council felt that it should reciprocate with the highest honour it had to bestow.

McCURDY AWARD—1959

The McCurdy Award is the premier award in the aeronautical technical field in Canada. The Award was established by the Institute of Aircraft Technicians in 1954, the year in which the IAT became one of the constituent bodies of the Canadian Aeronautical Institute. It consists of a Trophy and a Silver Medal.



Dr. Theodore von Kármán, Honorary Fellow

Mr. C. A. Grinyer (r) receiving the McCurdy Award from the hands of the Hon. J. A. D. McCurdy.

Each year nominations are invited from the Industry, the Armed Services, University and Government Research Establishments and all members of the Institute; these nominations and their supporting citations are carefully considered by a special Committee, which submits its findings and recommendations to the Council.

The President announced that the Award for 1959 would be presented to Mr. C. A. Grinyer, Project Manager of the Nuclear Power Plant Division, Atomic Energy of Canada Limited for his contribution to aeronautical engineering while at Orenda Engines Limited. He called upon the Secretary to read the official citation. This was as follows:—

Mr. C. A. Grinyer

"Mr. Charles A. Grinyer was born in 1903 at Sydenham in England, where he received his early education. He continued on to an Intermediate B.Sc., London University, the Advanced Mechanical Design Diploma and the Constructional Engineering Diploma.

"In the early years of his career he worked on combustion problems in the gas utilities industry and on centrifugal and axial flow compressors, at a time when they were virtually unknown in the aero engine industry. His first contact with turbojet engines came in 1941 as Technical Assistant to the Deputy Director of Engine Inspection in the Ministry of Aircraft Production, as it then was. In this position he was responsible for coordinating all test procedures in the British gas turbine industry and he had an opportunity to become completely familiar with all British companies engaged in the design, development and manufacture of gas turbine engines and their fuel systems. In 1946 he joined the Bristol Aeroplane Company and for the next five years, as Chief Turbine Development Engineer, he played an important part in the development of the Theseus turboprop, the early models of the Proteus turboprop and the Phoebus, which was a pure jet version of the Proteus.

"Mr. Grinyer came to Canada in 1952, when he joined the Gas Turbine Division of A. V. Roe Canada Ltd., as Assistant to the Chief Development Engineer. He was appointed Chief Engineer of Orenda Engines Ltd. in 1954 and, later in the same year, Vice-President, Engineering. In these positions he was largely responsible for the remarkable development of the Orenda 11 and 14 engines, which have given such good service with the R.G.A.F. In addition he led and coordinated the first-class technical team which designed and developed the Iroquois engine.

"One of Mr. Grinyer's chief attributes is his ability to visualize a logical sequence of development and thereby set a detailed plan which will attain the desired goal. The design of the Iroquois for high Mach Number applications represented a tremendous step forward in technical thinking and probably no other engine of its size in the free world has yet reached such an advanced stage in its development programme. Mr. Grinyer's

Mr. J. C. Vrana (r) receiving the Baldwin Award.

contribution to this project was an outstanding achievement in Canadian aeronautical engineering, deserving high recognition and the Institute's premier award."

The President asked Mr. Grinyer to come forward and invited Air Commodore McCurdy to make the presentation. Mr.Grinyer graciously acknowledged it, paying tribute to the team which he had led, though he was no longer associated with it. He asked that his thanks should be conveyed to all who had worked with him at Orenda Engines Limited.

F. W. (CASEY) BALDWIN AWARD

The F. W. (Casey) Baldwin Award is presented annually to the author of the best paper, in terms of originality of material and writing skill in presentation, published in the Canadian Aeronautical Journal during the preceding calendar year. It was first awarded in 1957. (The W. Rupert Turnbull Lecture is invariably published in the Journal but it is excluded from competition.) The Award consists of a Silver Medal.

Selection is made, firstly by the Publications Committee, which submits three choices to the Council, and secondly by the Council from these three choices.

Mr. J. C. Vrana

The President announced that the recipient of the Award would be Mr. J. C. Vrana for his paper entitled "Pressure Drop and Mixing in Burners", which had been published in the October 1959 issue. He asked Mr. Vrana to come forward, and presented the Medal. In a few words of acknowledgement, Mr. Vrana referred to the help he had received from colleagues at the National Research Council and later at the Canadian Pratt & Whitney Aircraft Company Limited, in the work on which the award-winning paper was based.

W. RUPERT TURNBULL LECTURE

The W. Rupert Turnbull Lecture is delivered annually by an eminent scientist or engineer selected by the Council. In the past year it has been customary to invite Canadians and non-Canadians in alternate years. The Lecture was established in 1955 to commemorate the pioneering work of Dr. Turnbull of Rothesay, N.B., some of which predated the first flight by the Wright Brothers.

The Lecturer receives a Certificate and an Honorarium.

In introducing this year's Lecture the President said

"Wallace Rupert Turnbull was born in St. John, N.B., on the 16th October, 1870, and died at Rothesay on the 26th November, 1954. After his early training as an electrical engineer he set up a consulting practice in Rothesay, N.B. in 1901 and almost immediately began active research in aerodynamics. In a building known as Anderson's Barn he built the first wind tunnel in Canada in 1902 and during the next few years he did some basic scientific work on the behaviour of aerofoils and the efficiency of aircraft design. In 1908 he presented a paper entitled "The Efficiency of Aeroplanes, Propellers, Motors etc." for which he received the Bronze Medal of the Aeronautical Society of Great Britain.

"His interest in propeller efficiency, about which very little data existed, led him to some classic studies which were a significant contribution to the art.

"During the Great War he worked in England, where he developed his ideas on variable pitch and built a 28" diameter model of a variable pitch propeller in July 1918, on which an RAF development contract was based. The contract was never completed but the first full sized propeller was shipped to Canada, after Dr. Turnbull's return to this country, and completed at Rothesay in 1922; it was unfortunately destroyed in a hangar fire. An improved version was designed and built in 1925 and eventually flown by the RCAF at Camp Borden in 1927. This was the world's first successful variable pitch propeller and the Turnbull patents formed the basis of the electric propellers of the Curtiss-Wright Corporation and, later, of Rotol.

"Dr. Turnbull was a man of many and varied engineering interests covering hydroplanes, torpedo screens, bomb sights, consolidated wood and tidal power, but it is as a pioneer in systematic and scientific research in aeronautics that he is remembered by the Institute and annually commemorated by the W. Rupert Turnbull Lecture."

The President then announced that Mr. A. E. Raymond, Senior Vice President, Engineering, of the Douglas Aircraft Company had been invited to de-

Mr. J. B. Edwards (l), who presented the Turnbull Lecture on behalf of Mr. A. E. Raymond receiving the Certificate from the President.

liver the Lecture. Mr. Raymond was on the point of retirement and it seemed to be fitting that the Institute should grant this recognition of a distinguished career, which had profoundly affected aviation in Canada. Then the President added that he had some bad news. Mr. Raymond had been on a tour of Europe and, most regrettably, had suffered a leg injury a few days before, which prevented his giving his Lecture in person. He read the following cable that had arrived on the previous Saturday:—

"I find myself almost totally immobilized for next few days due to leg injury. Doctor will not allow me to give Lecture in Ottawa Tuesday. Consequently have asked Edwards to substitute and he will contact you directly. Greatly regret this turn of events which is due to unfortunate but not serious accident. Please convey my good wishes to all Institute members and tell them how very sorry I am not to be able to be present in person.

A. E. Raymond"

He said that, with the Institute's permission, he proposed to write to Mr. Raymond expressing deep regret and sincere hopes for his speedy recovery.

The President then welcomed Mr. J. B. Edwards, Assistant to Mr. Raymond, who had hurried from Santa Monica over the week-end to take Mr. Raymond's place.

Mr. I. A. Gray moving the vote of thanks to Mr. J. B. Edwards after the Turnbull Lecture.

The Lecture, entitled "Development of Air Travel by Jet", will be published in the next issue of the Journal, and a summary at this time would be out of place. Mr. Edwards gave a very capable presentation and concluded by showing an excellent and honest film on the flight testing of the DC-8.

It is traditional that there should be no discussion after the W. Rupert Turnbull Lecture. At the President's request Mr. I. A. Gray, Operations Manager of Canadian Pacific Air Lines, thanked Mr. Edwards on behalf of the Institute for a very stimulating address.

The President then presented the Certificate and cheque to Mr. Edwards and asked him to convey the Institute's greeting to Mr. Raymond on his return.

The Honours and Awards Session was then adjourned.

TEST PILOTS SECTION SYMPOSIUM

To be held at

HALIFAX-DARTMOUTH

18th and 19th November, 1960

Details will be published in the next issue.

ANNUAL REPORT

of the Council

1959-60

THIS Council took office at the Annual General Meeting last June, at Ingonish, Nova Scotia. That very unusual Meeting included the unveiling of a monument at nearby Baddeck, to mark the 50th Anniversary of Powered Flight in the British Empire; outwardly it was a happy occasion. But it was held in the shadow of the distressing events of the previous February and the new Council was under no delusions about the difficulties that lay ahead. Although steps had been taken promptly to reduce the Institute's expenditures as far as possible without seriously affecting its operations, it was difficult to know how practicable the "austerity" budget would prove to be or, in fact, to predict the Institute's probable income with any certainty.

The Council set out with a balanced budget and it has been fairly successful in living up to it. In the meantime it has taken the opportunity to review the Institute's function in the general scheme of things. It has done some serious thinking about the future and it believes that the Institute can now look forward to resumed growth and to expanded service to its members.

COUNCIL AND EXECUTIVE COMMITTEE

The Council has met whenever an Institute Meeting has served to bring the members together – firstly at Ingonish, secondly in Toronto at the time of the Anglo-American Conference, thirdly in Edmonton just before the Mid-season Meeting, and finally yesterday. At each of these meetings the attendance has exceeded 50% (the remainder being represented by proxies) which is creditable when one considers that the members of the Council are drawn from the whole breadth of the country and that the funds available for travelling have been strictly curtailed.

In addition the Executive Committee has met six times, usually in Ottawa, but on one occasion in Toronto in a joint meeting with the Planning Committee.

The Council for 1958-59 had spent its whole term of office debating reforms in the constitution of the Council itself. It handed on to its successor a carefully considered proposal and recommended that it should be implemented by appropriate amendment of the Bylaws. This has been done. The Amendment was submitted to the membership last November and adopted.

The new constitution retains the election of the members of the Council by the Branches but reduces their number, roughly by 50%, and increases the term of office of individual members from two to three years. Consequently each of the smaller Branches will elect a member of the Council only once in three years, instead of every year as in the past; the larger Branches will elect Councillors twice or three times in three years, depending on their membership. By these measures the Council will become both more experienced and of a more convenient size.

The transition from the old arrangement to the new will take time and will not become fully effective – that is, the new routine for the election of members will not be in complete operation – until 1963. In the meantime a scheme of transition has been introduced, whereby the smaller size of the Council will be realized after this Annual General Meeting. This will be done by simply allowing the existing members of the Council to complete their terms under the old constitution and not electing anyone to replace those due to retire this year. Some of those who will serve next year will be replaced by election in 1961, while others will be asked to serve for extended terms to provide the overlaps which are a feature of the new arrangement.

As a result, after this Meeting, the Council will be reduced to 13 – and this 13 will include a new seat for a member from Quebec, where a Branch has only recently been formed. Under the old formula the members of the new Council would have numbered 23.

COMMITTEES

The Committees that have served the Council during the year have comprised the usual five, namely, Admissions, Finance, Publications, National Programmes and Planning and, in addition, a special Committee appointed to examine the Institute's scheme of Honours and Awards. It is appropriate to say a few words about the composition and work of each of them.

Admissions Committee

The Admissions Committee was again located in Ottawa, where it could work in close touch with Headquarters staff. G/C E. P. Bridgland was its Chairman, with Commander N. A. Smith, Mr. C. K. Rush and, until recently, Mr. A. D. Wood as its members; Mr. W. A. Chisholm, the Assistant Secretary, served as Secretary of the Committee. The Committee met at fairly regular intervals throughout the year to study applications for admission and regrading. It has worked smoothly and rapidly but, as in all procedures involving personal circumstances, some delays and difficulties have been experienced in dealing with a few cases. The Council has no suggestion to make which would improve the present admissions procedure; it seems to have settled down satisfactorily and it is recommended that it should continue as it is.

Finance Committee

The Finance Committee faced a particularly difficult year. Mr. Boyd, the Vice-President, was invited to accept the Chairmanship of this Committee and, to avoid disruption in these critical months, Mr. A. E. Ades and Mr. D. R. Taylor, who had served in 1958-59, were asked to serve another year. This was a departure from the tradition that the Committee should alternate between Montreal and Toronto; but the critical financial problems of 1959 seemed to warrant it.

The Committee worked hard. Mr. Boyd carried out a personal and detailed examination of the Headquarters bookkeeping methods. With the Treasurer, he kept a close watch on the development of the year's expenditures. He sought advice on the Institute's bonds and investments. And he completed the work of his predecessor, Mr. Ades, in developing a plan for the extension of Sustaining Membership to embrace a wider section of the Industry. The Council is most grateful for his unsparing effort, which has undoubtedly controlled what might otherwise have been a serious financial crisis. The situation is still grave; the Institute's finances are everybody's business and the Committee will need all the help it can get from the membership in the next few years.

Publications Committee

The Publications Committee has been in the capable hands of Mr. H. C. Oatway, who served on this Committee when the Journal was established in 1955.

The other members have been Mr. J. A. Dunsby, Mr. J. J. Eden and W/C D. A. MacLulich.

Their major problem has been the question of advertising, which, of course, fell off sharply after February 1959. The firm of Allin Associates, a media representative, has been appointed to promote the sale of advertising space – without any marked improvement so far. (However it is understood and recognized that any change will take time, especially in the present rather depressed state of the Industry.)

The Committee has made one or two very helpful suggestions to enhance the usefulness of the Journal, notably the introduction of index cards and a plan to encourage the retention of the various issues in bound volumes at a very reasonable cost. In this they have emphasized that the cumulative effect of the Journal, as a fund of reference and a history of development of the art, is one of its chief attributes; everything that can be done to promote this effect makes the Journal a more useful instrument to the aeronautical engineer.

As an economy measure, preprints of the papers to be presented at the Institute's meetings have been discontinued for the time being. However the *List of Members* which was not published in 1959, will be reinstated this summer.

Before leaving the subject of publications, the Council would like to express its thanks to the members of the Editorial Board, who have worked diligently and wisely in the assessment of material submitted for publication in the Journal. They have maintained a satisfactory level; in fact the quality and reputation of the Journal continue to improve.

National Programmes Committee

The National Programmes Committee is responsible to the Council for the programmes of the Institute's meetings and it is also charged with helping the Branches with the provision of tour speakers and the co-ordination of their respective programmes where necessary. A/C W. P. Gouin has been its Chairman this year, assisted by Dr. J. C. Arnell and G/C D. M. Holman. The very well-balanced programme of the Mid-season Meeting was the first demonstration of their ability and the technical sessions of this Annual General Meeting promise to maintain that standard.

A tour speaker, Mr. G. D. Watson, was arranged for the Edmonton, Cold Lake and Winnipeg Branches in January. Admittedly this was not enough and the Committee has recognized that its planning must be advanced by several months, if it is to render the service to the Branches which the Council believes to be desirable. Accordingly the tour speakers for next fall and next spring have already been tentatively arranged.

To help the Committee in its general service to the Branches, the Branch Chairmen were appointed to serve on the Committee last February. It is recommended that this practice should be continued, since, after all, the Branch programmes are the raison d'être of the Branches and the Branch Chairmen have an overriding responsibility for them.

Planning Committee

The Planning Committee is responsible for "creative thinking". Its job is to look ahead and to provide the Council with ideas about the development of the Institute's work, facilities and finances. It is not easy to read the crystal ball nowadays but the Committee under Mr. G. F. W. McCaffrey's Chairmanship has done some imaginative work. Mr. S. L. Britton, Mr. K. W. Jay and Professor E. D. Poppleton, all of Toronto, have been the members of this team of strategists.

Awards Review Committee

The Council of 1958-59 recommended that the present Council should set up a Committee to review the Institute's various Honours and Awards, since there appeared to be overlapping, lack of definition and other weaknesses which were rather unsatisfactory. Accordingly a Committee, known as the Awards Review Committee, was appointed; Mr. E. H. Higgins was its Chairman and its other members were G/C H. R. Foottit, Mr. I. M. Hamer and Mr. T. E. Stephenson.

This Committee worked by correspondence and submitted several interim reports as their work progressed. These were carefully studied and discussed by the Council and by the Executive Committee of the Council, and passed back to Mr. Higgins with comments. Finally Mr. Higgins attended an Executive Committee Meeting and a final scheme was drawn up; this has now received Council approval and will be put into effect in the coming year.

HEADQUARTERS

The Headquarters staff still numbers only 5, to which it was reduced in the spring of 1959. By cutting out some operations and by arranging for the larger and wealthier Branches to handle their own addressograph work – in which they have been most co-operative – it has been possible to maintain substantially the same services as before.

There have been no staff salary increases since November 1957, nor can any be envisaged for this year. The Council would like to express its appreciation of the loyalty and understanding of the staff, who have accepted the situation without question and are carrying a great deal more than a normal load of work. One thing has been done for them, though a very small item; a plan of medical and surgical insurance, to which the employees pay half, has been introduced to cover those members of the staff not covered in other ways. It was felt that such a scheme had to be established, if the Institute had any pretensions to being a decent employer.

With the reduced staff and no immediate prospects of increasing it, the Headquarters office space was considered to be too big. Since a move to smaller accommodation would have cost more than any likely saving in rent, it was decided to sublet some of the space. A very happy solution was found when the Garrett Manufacturing Company, one of the Institute's Sustaining Members, rented the space for their Ottawa representative, Mr. B. D. Darling.

BRANCHES

As usual the Branches have done good work throughout the season. The Toronto Branch was, of course, seriously affected by the cancellation of the Arrow/Iroquois project and at the beginning of the season it appeared – to the casual visitor at least – to be suffering from a severe case of depression. But, when the President and the Secretary visited the Branch in February, they found a more cheerful and hopeful atmosphere and it is understood that attendance at Branch meetings has rallied satisfactorily.

The President and the Secretary also visited the western Branches in January, attending meetings at every one, and the Secretary attended meetings in Montreal and Halifax-Dartmouth in March and April. Though each Branch had its peculiar problems, each was essentially in good health and running an active programme of meetings. The Ottawa Branch too has had a successful season.

If evidence of the returning vigour of the Institute were needed, the formation of a new Branch at Quebec can be cited. This brings the number of Branches to 10. The Quebec Branch came into being early in March and it is a great pleasure to welcome a member from Quebec to the Council for the coming year.

SECTIONS

The Specialist Sections have had varying fortunes during the year. Neither the Test Pilots Section nor the Propulsion Section has been very active. The Astronautics Section has done better, but here again it has been good only

in parts. The Montreal Group of the Astronautics Section has developed a very creditable programme, quite independent of the Branch programme, and has held what it calls "Discussion Evenings" almost monthly since the New Year: on the other hand very little has taken place in Ottawa and Toronto, the other two strongholds of the Section.

The Chairman and Vice-Chairman of the Section, Mr. D. Bogdanoff and Dr. H. J. Luckert, both live in Montreal and this fact has undoubtedly accounted for much of the Section's success; they have been able to meet and decide to do things. Fortunately the other Sections have learned this lesson and each has arranged that all the members of its 1960-61 Executive Committee will be located in one city. It is understood that the seat of the Executive Committee will change from year to year, according to a set scheme of rotation.

ASTRONAUTICS

The growth and activity of the Toronto Group of the Astronautics Section have been curtailed to some extent by the concurrent existence of the Canadian Astronautical Society in that city. There is a similar organization, the Astronautical Society in Canada, in Montreal. Both of these Societies, because of their names and because they require no strict qualifications for membership, are attractive to people generally interested in the prospects of space travel, exploration and colonization. Both Societies are run on very limited financial resources but almost unlimited enthusiasm. They organize good programmes and they are undoubtedly doing valuable work in the dissemination of information.

When these Societies were formed, early in 1958, the Executive Committee held discussions with them in an attempt to persuade them to cast in their lot with the Institute's Astronautics Section. The attempt failed, primarily on the grounds of membership qualifications; they insisted that voting members should include anyone, from any walk of life, who was able to "contribute" – presumably to a parallel walk of life in outer space; the Institute could not agree to such dilution of its voting grades. Last September Dr. Patterson, Past President of the Institute, who was engaged in the negotiations in 1958, was approached by the CAS with further proposals for some sort of merger. This was followed up and, in February, the Executive Committee met the Officers of the CAS in Toronto to examine the possibilities. Some progress was made at least towards an understanding of the problem, and the negotiations are continuing.

It is understood that the ASC and the CAS have now joined forces; which is as it should be. But it must be confessed that a merger between the Institute and these Astronautical Societies seems unlikely – even undesirable, if both are to remain true to their principles. The differences in philosophy are fundamental and, if they are understood, it will be seen that there is a place for both and that co-existence is perhaps preferable to an unhappy marriage.

The Council has contended that membership of the CAI must mean something – it must have some significance in the profession of aeronautics. Whatever the respective definitions of the words "aeronautics" and "astronautics", so far as the Institute is concerned the key syllable is "nautics"; in other words, "the ship" – and, rather exclusively, everything associated with its creation and operation. There are the classic disciplines of mathematics, fluid-dynamics, propulsion and structures; there are the associated arts and sciences, navigation, environment, human engineering and sundry branches of medicine, operations, telecommunication and so on. All these have a bearing on the man-machine and its operation, and those practised in these arts, sciences and engineering have a place in the Institute. But geologists, agriculturists, botanists, sociologists, international lawyers, military strategists, construction engineers and the rest do not, – except perhaps in certain "vehicle-specialist" fields. If such people were admitted as full voting members they would be able to influence the Institute's affairs – if not actually control them – without being able to contribute to the "art, science and engineering" to which it is dedicated.

On the other hand such people can probably contribute to the speculations about life in space and, if the Astronautical Societies are intended for mutual education in this broader field, their voting membership must be drawn from every branch of human experience. A member will not enhance his professional status but he will become better informed. Membership in these Societies can mean no more than that the member is qualified to discuss some of the myriad problems presented by the penetration of space, which cover every facet of extraterrestrial existence. In contrast to membership in the Institute, membership in these Societies does not reflect the member's reputation, experience or standing in his chosen career; in brief, it has no professional significance.

This situation has been explained at some length to show that there are valid objections to any merger between the Astronautical Societies and the Institute. The Council has been imbued with a sincere desire to find some reconciliation, since the existence of two apparently similar groups is confusing to say the least, but it is being forced to the conclusion that the differences are, in fact, basic and the similarities superficial.

However, as has been said, negotiations are continuing.

MEMBERSHIP

A decrease in membership was to have been expected, after the storms that have decimated the Industry. Actually the decrease has not been so serious as had been feared; at the end of the fiscal year, on the 31st March, the membership stood at 2,084, compared with 2,281 a year before. Unfortunately this is probably not the end of the story, since several members who retained their membership on going south of the border or across the Atlantic may let it lapse this year, as their ties to Canada grow more tenuous. However, applications are still coming in steadily and, if the services to members can be improved, the membership should begin to build up again.

Of course being a member of the Institute means different things to different people but, broadly, it is beginning to assume some professional significance. Employers are getting to recognize it; some government assessments take it into account. Because admission is not open to everybody and because the grading is done very carefully and conscientiously, membership does give some indication of one's general standing in the field. It is not, of course, a conclusive indication – but what qualification is?

For this reason the size of the membership is not so important as its quality and sincerity. The Institute must never lose sight of the fact that it is trying to build up a responsible and dedicated body of aeronautical scientists and engineers, and to serve their professional lives as well as it can.

PROGRAMMES

This brings up the question of programmes. Last year was unusual in that the celebration of the 50th Anniversary and the incidence of the Anglo-American Conference necessitated a considerable departure from the normal routine. The Annual General Meeting was held in Cape Breton, where a relatively few members could attend, and the IAS/CAI Meeting was abandoned in favour of the Anglo-American Conference, which took place, in the main, in New York. Not until the Mid-season Meeting last February did the programme return to

normal and the excellent attendance at that Meeting, from most of the western Branches, was evidence of its worth.

The Council and the National Programmes Committee have felt that the programmes of Institute Meetings should be simpler, less diversified and more penetrating than they have been in the past. They should be more directly applied to Canadian needs and the individual papers should treat their respective subjects fairly specifically. On the assumption that, for the time being at any rate, the Canadian Industry is not likely to become involved in the design and development of advanced military aircraft, attention has been directed to the various aspects of air transport, particularly arctic requirements, and to the coming activities in the exploration of near space, a field in which this country, situated as it is in the auroral belt, has always played a prominent part from the ground.

This policy was evident in the programme of the Mid-season Meeting, including papers on fuels and oils, auxiliary power for spacecraft, airline maintenance, bearings and propellers – all solid engineering stuff. The programme of the sessions at this Annual General Meeting is similarly cast. For the IAS/CAI Meeting in the fall the programme will be confined to areas of reciprocal interest to Canadians and Americans; this meeting is, in essence, an opportunity for the scientists and engineers of each country to learn something useful from the other; it must never be allowed to become a mere social event draped around a rather pointless collection of shallow lectures.

Before leaving the question of programmes, reference should be made to the two-day Symposium which has been planned jointly by the Astronautics Section and the National Research Council. It will be held in Ottawa in October and will be concerned with the Canadian high altitude research programme of the next two or three years. This again will deal with specific short-range plans. A very interesting list of speakers and topics is being prepared.

INTERNATIONAL ACTIVITIES

In the field of international activities the Institute has continued to keep in close touch with the Royal Aeronautical Society and the Institute of the Aeronautical Sciences – and, to a rather lesser extent, with the American Rocket Society.

Anglo-American Conference

Last October, for the first time, the Institute took part in the Anglo-American Conference, which was held in New York. Two Canadian papers were presented – by Dr. G. V. Bull and Mr. R. D. Hiscocks – and CAI members were admitted on the same footing as members of the RAeS and IAS. The Conference ended with a two-day visit to Toronto and this, really, was something of a disaster. The plans were laid when the Arrow and Iroquois programmes were in full swing; their cancellation left the Institute with a commitment but deprived of its two prize showpieces and, significantly, of much of the enthusiasm and strength formerly so evident in the Toronto Branch. With the help of De Havilland, the Defence Research Medical Laboratories and the Institute of Aerophysics, a fair programme was put together; but it was inevitably a poor substitute for what might have been.

The Royal Aeronautical Society has kindly extended an invitation to the Institute to participate in the next Anglo-American Conference, which will be held in England in 1961. Little more can be said about this at present; no doubt the plans will unfold in more detail during the coming months.

International Council of the Aeronautical Sciences

The International Council of the Aeronautical Sciences will hold its Second Congress in Zurich in September. It will be remembered that Dr. J. J. Green and Dr. G. N. Patterson represent Canada on this Council and that the CAI is responsible for the organization of the Canadian delegations to its Congresses. Its First Congress was held in Madrid in 1958.

Three Canadian papers will be presented on this occasion. The Council hopes that the Canadian delegation will be a strong one and would point out that anyone who may be interested in attending can obtain particulars from the Secretary.

VISIT OF H.R.H. THE PRINCE PHILIP

A most significant event of the year was the Institute's participation, with the Canadian Council of Professional Engineers, the Canadian Institute of Mining and Metallurgy, the Chemical Institute of Canada and the Engineering Institute of Canada, in a Luncheon to His Royal Highness The Prince Philip, Duke of Edinburgh. This took place in Toronto on the 29th June, during the Royal Tour. Although it was unfortunate that his busy time table did not permit him to attend a function which was exclusively aeronautical, it was a great pleasure to met the Institute's Patron in this distinguished company of fellow engineers and to hear his address. Incidentally at the Reception preceding the Luncheon, His Royal Highness accepted a lapel pin from the Secretary, and was keenly interested in the 50th Anniversary celebrations and in meeting Air Commodore McCurdy.

BYLAWS AND REGULATIONS

Reference has been made to the Amendment of the Bylaws adopted this year, changing the constitution of the Council. Other provisions of the Bylaws were also amplified and brought up to date by that Amendment, but their substance was not materially affected. Concurrently with the introduction of the Amendment, the Council authorized certain changes in the Regulations. The Regulations express the Council's rulings; they are regulatory rather than legislative and therefore amendment of the Regulations does not require a vote of the membership. For general information, it might be well to summarize this year's Amendments in this report.

Name

To establish an officially approved version of the name of the Institute on those relatively rare occasions when it is used in French, the Council decided on "L'Institut Aéronautique du Canada".

Branch Financing

The formula for the financing of Branches which has been used hitherto has not proved very satisfactory. On the basis of payments of $2.00 a year for every member of the Branch, the larger Branches tended to build up huge surpluses – which had to be refunded – while some of the smaller Branches found that they did not have sufficient. To achieve a distribution more realistically related to the needs of the Branches a new formula has been introduced, to go into effect in the coming year. This formula expresses a parabola and, under it, the smaller Branches will receive more and the larger ones less, than they would under the old linear relationship. The total sum remitted to all the Branches added together will remain substantially unchanged; only the distribution will be altered.

In terms which CAI members should appreciate, the new formula is "Dollars $= 30\sqrt{\text{Branch membership} - 20}$". The old one was "Dollars $= 2 \times$ Branch membership".

Certificates of membership

The issue of Certificates of Membership to those admitted to the non-technical grade of Associate has been discontinued.

Advancement in grade

Four references, in place of two, must now be given in support of each application for advancement in grade; moreover two of the referees must be of grades higher than that of the applicant.

Election of Fellows

The rules for the nomination of Associate Fellows for election to the grade of Fellow have been slightly modified.

Committee terms of reference

The terms of reference of the various Institute Committees have been revised and brought up to date.

Incidentally, if anyone is interested, copies of the amended Bylaws and Regulations can be obtained from the Secretary. They are not distributed automatically to all members.

ELECTION OF FELLOWS

Two things remain, the announcement of the results of the election to the grade of Fellow and the introduction of the new Council.

Each year it is the responsibility of the Council to elect members to Fellowship of the Institute. To be eligible a member must have been an Associate Fellow for at least one year and he must be nominated by members of the Council or by existing Fellows. It is a secret ballot carried out by mail.

The Fellows elected this year are
Mr. A. E. Ades
G/C E. P. Bridgland
Dr. W. R. Franks
Mr. A. H. Hall
Miss E. M. G. MacGill
Dr. P. M. Millman
Dean D. L. Mordell
Dr. H. S. Ribner
Mr. F. R. Thurston
Dr. C. H. E. Warren

NEW COUNCIL

As for the new Council, it has already been explained that, except for the member from Quebec, all its members will have served on the retiring Council. It might perhaps be more appropriate, in these circumstances, to announce the names of those who will not continue to serve in the coming year. But that would be confusing.

One of the provisions of the revised constitution of the Council concerned the election of the President and Vice-President. In the past these Officers have been elected immediately before the Annual General Meeting, to take up their exacting duties immediately after it; any member of the Council, perhaps attending his first Council Meeting, was liable to find himself President, with effect from the day after tomorrow. This could be a severe shock to the system and the Institute is fortunate that all its Presidents and Vice-Presidents have survived their first weeks in office! The revised procedure provided for the election of the President and Vice-President at least two months before the Annual General Meeting, giving the Officers-elect a little time to study the situation before having to assume their responsibilities.

Accordingly the President and Vice-President for 1960-61 were elected by the Council at the time of the Mid-season Meeting in February. They are

Mr. David Boyd, President, and
A/C W. P. Gouin, Vice-President

The other members of the Council for the coming year will be,
Dr. D. C. MacPhail (Past President)
Mr. G. F. W. McCaffrey
Dr. J. H. T. Wade
Mr. E. H. Higgins
Mr. G. W. T. Roper
Mr. J. G. Davidson
F/O A. J. Robinson
F/L L. S. Lumsdaine
CDR E. B. Morris
Mr. W. E. Jamison
Dr. J. J. Green

The year ahead will be an eventful one. The Council will have to exercise care and judgment, and it will depend on many Committees, Branches and Sections, for responsible advice. Every member of the Institute must remember that he has a share in this responsibility and that very many shortcomings in money and facilities can be offset by a little enthusiasm.

There are hopeful signs that the shock of 1959 has subsided; things are gradually beginning to improve. In Canada, as in the rest of the aeronautical world, profound changes are taking place. Regrouping and reappraisal of the problems of human flight are the order of the day. It is important that Canadian aviation should close its ranks, that Industry, Government and University Research Establishments, the Airlines and Operators, and the Armed Services should become ever more closely co-operative and that the CAI should assume its responsibilities in this alliance. It has an indispensable part to play; it must make itself fit to play it.

Report of the Admissions Committee 1959-60

The Admissions Committee for 1959-60 was appointed by the President with the following members:

Chairman–G/C E. P. Bridgland
Members–CDR N. A. Smith
Mr. C. K. Rush
Mr. A. D. Wood
Secretary–Mr. W. A. Chisholm
Adviser–Mr. H. C. Luttman.

The organization and method of operation of the Committee was the same as that followed in the two previous years.

The Committee held eleven meetings during the year compared with eighteen during the previous year. The reduced number of meetings may be directly attributed to the reduction in number of applications received during the past year. The number of applications dealt with during the year are compared with those of the previous year (in brackets) in the accompanying table.

	Admissions	Regradings
Associate Fellow	8 (29)	11 (8)
Member	45 (124)	16 (14)
Associate	4 (15)	Nil (1)
Technical Member	32 (111)	7 (33)
Junior Member	2 (6)	5 (7)
Student	87 (59)	Nil (Nil)
TOTAL	178 (344)	39 (63)

During the year seven applications for regrading were turned down. At this time thirty-nine applications are awaiting references required for processing.

In summary, the number of applications for membership has dropped to approximately half that of the 1958-59 season. It is considered that this is a result of the reduced activity in the Canadian aircraft industry. However, it is encouraging to note that there was a substantial increase in the applications for student membership.

Report of the Publications Committee 1959-60

This year your Council nominated a Publications Committee composed primarily of members from the Ottawa area. We will not go as far as saying that this resulted in any marked improvement in the quality of the Committee, but we believe it is safe to say that it certainly resulted in a marked improvement in attendance at meetings. During the year four meetings were held, and we are happy to report that all of the members made a very serious effort to carry the Journal through a trying year.

Problems which have plagued the Journal since its first issue, are still with us. It seems that editorials, scientific papers, or even technical descriptive articles are shunned by our members like the plague. We would hope that in the future, the Branches will recognize our needs and help out in every way possible.

Retaining our self-respect financially was an ever recurring problem this year. Advertising revenue fell off sharply after February 1959. The firm of Allin Associates, a media representative, was appointed by your Council to promote the sale of advertising space, without, we might add, any marked improvement so far. However, hope springs eternal, and we trust that returns next year will restore our faith in humanity, and more particularly in Allin Associates.

Despite an increase in the quantity of technical data published, our printing costs remained relatively unchanged.

As an economy measure, preprints of the papers to be presented at the Institute's meetings have been discontinued for the time being. However the *List of Members*, which was not published in 1959, will be reinstated this summer.

The Committee has made one or two helpful suggestions to enhance the usefulness of the Journal, notably the introduction of index cards and a plan to encourage the retention of the various issues in bound volumes at a very reasonable cost. In this way they have emphasized that the cumulative effect of the Journal, as a fund of reference and a history of development of the art, is one of its chief attributes; everything that can be done to promote this effect makes the Journal a more useful instrument to the aeronautical engineer.

Mention must, of course, be made of the efforts of the members of the Editorial Board, who have worked diligently and wisely in the assessment of material submitted for publication in the Journal. They have maintained a satisfactory level; in fact the quality and reputation of the Journal continue to improve.

We wish also to express the Committee's appreciation of the efforts of the staff at C.A.I. Headquarters. It is primarily through their efforts that the editorial standards of our publications continue to improve.

Report of the Finance Committee 1959-60

In his report to the Annual General Meeting in May 1958, Mr. P. B. Dilworth, Finance Committee Chairman, warned that the general financial situation appeared unstable and would bear watching. Recent history shows that he was really prescient. He could not, however, foresee the debacle of February 1959 or its repercussions.

To attempt a detailed report on finances for the year 1959-60 would involve tedious detail and it is believed that the salient facts should be presented and compared with past records.

Comparison of Audited Statements

A tabular comparison of audited statements for the years ending in March '58, '59 and '60 will give members a clear picture of the general trend. All figures are rounded off to the nearest hundred dollars for clarity.

Year	Revenue	Expenditure	Difference
1957/58	$76,750	$68,950	$7,800
1958/59	75,300	71,800	3,500
1959/60	64,600	68,600	—4,000

It will be seen that operations for the year just closed produced a net deficit of $4,000. Council recognized that the situation was such as to demand caution and, with that in view, economies were introduced.

These economies were:

(a) elimination of membership list,
(b) sub-let of office space, and
(c) staff reduction.

The budget adopted was $62,300 and it was hoped that it would show a balanced condition at year end. It should be noted that the budget envisaged a reduction of over fifteen per cent. Reference to the tabulation shows that actual revenue was $64,600 or an increase over budget of $2,300.

Economies were effected in the Headquarters operations totalling over $3,000. In addition, revision of bookkeeping methods to get proper distribution of indirect charges to the various projects, such as Meetings, Publications etc, was undertaken in order to show the actual status of each activity. This is a most desirable change but renders it difficult to make detailed comparisons between the latest audited statement and those of previous years.

Expenditures in the past year 1959-60 were in excess of budget by $6,291 and exceeded revenue by $4,011.

Salient factors causing this deficit were a drop in advertising revenue, failure to budget for the Baddeck monument, to make provision for depreciation on capital equipment.

During the year effect was given to a new schedule of fees for Sustaining Members. This was urged upon the Council by major Sustaining Members and will represent a serious loss of future revenue.

The new method of allocating indirect expense to each of the main projects shows that the Journal is a very serious drain on the Institute. The publications section of the revised accounts shows a loss of $11,000.

During the past year opportunity was taken to investigate the detailed bookkeeping procedures utilized by the Headquarters staff, to check the bank accounts and to verify the securities in the various funds. It is a pleasure to report that the account books are most meticulously maintained in a current condition and that proper vouchers are available for all disbursements. All receipts are properly identified by suitable entries. The Staff must be congratulated on a very thorough job.

The audited statement is available and will be published in the Journal.

It is my desire to thank Mr. Luttman for his effective and generous assistance in the handling of the financial affairs of the Institute for the past year.

AUDITORS' REPORT

To the Members,
Canadian Aeronautical Institute,
Ottawa, Ontario.

We have examined the balance sheet of the Canadian Aeronautical Institute as at March 31, 1960, and the statements of revenue and expenses for the year ended on that date. Our examination included a general review of the accounting procedures and such tests of the accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the accompanying balance sheet and statements of revenue and expenses present fairly the financial position of the Institute as at March 31, 1960, and the results of its operations for the year ended on that date, in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

ARMSTRONG, CROSS & CO.,
Chartered Accountants.

OTTAWA, Ontario,
April 21, 1960.

Statement 1

CANADIAN AERONAUTICAL INSTITUTE
BALANCE SHEET
(exclusive of Specified Funds)
As at March 31, 1960

ASSETS

Current:			
Cash on hand and in bank	$24,038.34		
Less: Due to Specified Funds	801.73		
		$23,236.61	
Accounts receivable		756.21	
Hydro Electric Power Commission bonds, 3½% due March 1, 1977 — at cost		11,970.00	
Accrued bond interest		104.06	
Prepaid medical and surgical premiums		191.24	
			$36,258.12
Fixed — at cost:			
Furniture and fixtures		4,491.83	
Less: Accumulated depreciation		2,331.83	
			2,160.00
			$38,418.12

LIABILITIES AND SURPLUS

Liabilities:			
Accounts payable and accrued charges		$ 1,774.46	
Fees received in advance		8,927.00	
Journal subscriptions received in advance		456.00	
			$11,157.46
Surplus:			
Balance — March 31, 1959		31,272.33	
Less: Net loss for the year — per Statement 2		4,011.67	
			27,260.66
			$38,418.12

Statement 2

CANADIAN AERONAUTICAL INSTITUTE
STATEMENT OF REVENUE
For the year ended March 31, 1960

Meetings			$ 8,738.02
Publications:			
Journal subscriptions		$ 5,103.75	
Advertising		10,414.49	
Sundry technical papers		491.00	
			16,009.24
Membership:			
Members' dues		15,497.44	
Entrance fees		815.00	
Sustaining members		21,850.00	
			38,162.44
Investment:			
Bond interest — Hydro Electric Power Commission 3½%		420.00	
Bank interest		296.05	
			716.05
Miscellaneous:			
Office supplies		228.62	
Lapel pins, Christmas cards and blazer crests		234.15	
Toronto Branch Grant		491.21	
			953.98
Total Revenue			64,579.73
Total Expenses — from Statement 3			68,591.40
Net Loss For The Year			$ 4,011.67

Statement 3

CANADIAN AERONAUTICAL INSTITUTE
STATEMENT OF EXPENSES
For the year ended March 31, 1960

MEETINGS:		
Dinners and facilities	$ 7,885.85	
Printing	955.52	
Staff travel	1,536.08	
		$10,377.45
PUBLICATIONS:		
Journal	17,171.10	
Sundry technical papers	280.00	
List of members	113.22	
Salaries and Headquarters expenses	9,617.57	
		27,181.89
REMISSION TO BRANCHES AND SECTIONS:		
Standard allowances	2,306.70	
Special allowances	57.09	
		2,363.79
MEMBERSHIP ROUTINE		244.50
SECRETARIAT:		
Salaries	16,374.74	
Staff benefits	727.15	
		17,101.89
HEADQUARTERS:		
Rent	3,112.50	
Insurance	43.85	
Telephone and telegraph	508.90	
General maintenance	27.00	
Office supplies	2,626.99	
Exchange and bank charges	218.94	
Legal and audit fees	104.00	
Miscellaneous	183.93	
Travel	1,201.69	
		8,027.80
CAPITAL EQUIPMENT:		
Provision for depreciation		449.18
FIFTIETH ANNIVERSARY MONUMENT		2,844.90
Total Expenses — to Statement 2		$68,591.40

Statement 4

CANADIAN AERONAUTICAL INSTITUTE
STATEMENT OF SPECIFIED FUNDS
For the year ended March 31, 1960

SCHOLARSHIP FUND:		
Balance — March 31, 1959	$18,589.08	
Interest earned	708.91	
		$19,297.99
AWARD FUND:		
Balance — March 31, 1959	1,777.05	
Interest earned	177.23	
	1,954.28	
Less: Expended	383.99	
		1,570.29
		$20,868.28
REPRESENTED BY:		
Cash on deposit	$ 1,809.68	
Dominion of Canada bonds — 4¼% 1972 (par $19,500.00) — at cost	18,256.87	
		$20,066.55
Due from General Fund		801.73
		$20,868.28

Report of the Planning Committee 1959-60

This year's Planning Committee can claim no spectacular success in shaping the future of the Institute but steady progress has been made in considering various aspects of its operation and advising Council.

Three formal meetings of the Committee were held during the year, one of which was a joint meeting with the Executive Committee. These were supplemented, on occasion, by telephone conversations and personal contact.

The outstanding problem of the Institute during the next few years would appear to be that of maintaining and expanding our present position of professional leadership of the aeronautical fraternity in Canada.

It is considered by this Committee that the present campaign to increase the number of members and Sustaining Members must be continued. At the suggestion of the Committee a modest brochure was prepared to help "sell" the Institute to potential Sustaining Members during this year's campaign.

One result of the reduced design and manufacturing activity in the Canadian industry has been to limit company sponsored attendance at general meetings of the Institute, particularly for personnel at the intermediate and junior levels. It would appear, therefore, that all possible attention should be directed toward increasing interest in Branch Meetings. The choice of speaker and subject are the most obvious factors in achieving this but many others such as notices, location, facilities and social amenities can be improved. Each member can also contribute by encouraging non-members to attend as guests.

On the subject of "Juxtaposition" which has been and will be discussed in Council, this Committee recommends that action on this be limited to exploring the possibility of integration of Headquarters facilities and/or publication activities. These steps could be linked to a general objective of the CAI of becoming the recognized agency for the publication of aeronautical literature in Canada. The latter is favoured by the Committee although it does not agree that it should be extended into the field of originating data sheets and specifications.

We should like to express our thanks to the UTIA for the use of the library as a meeting place.

Report of the National Programmes Committee 1959-60

BRANCH PROGRAMMES

The programmes of Branch meetings are by far the most important work of the Institute, since they are almost the sole purpose of the Branches' existence. Secondly, perhaps with some concession to the Journal, come the three annual meetings of the Institute, symposia and similar activities. Unfortunately the National Programmes Committee did not appreciate these truths until rather late in its term of office and it must be admitted that it did not pay the attention to the needs of the Branches that it should have done. However the Branches are capable of looking after themselves – in fact, it is primarily their responsibility to do so – and their programmes have been satisfactory. Really the National Programmes Committee's only contribution to the Branch programmes was the provision of a tour speaker, in the person of Mr. G. D. Watson, who visited the Edmonton, Cold Lake and Winnipeg Branches in January.

NATIONAL MEETINGS

In the national meetings, the Committee has done better. The rather small part played by the CAI in the Anglo-American Conference in October was planned before this Committee took office. The programmes of the Mid-season Meeting last February in Edmonton and of the Annual General Meeting need not be restated but the principles on which they were planned are these:

(1) That for some time to come Canadian aviation must concern itself primarily with air transport, particularly in the development of the arctic,

(2) That for the time being the days of sizable production runs are over and Canadian aeronautical engineers must concentrate on designing for, planning for and organizing production in limited quantities – in aircraft and all forms of aircraft equipment,

(3) That Canadian aeronautical engineers must be kept informed on the development of space technology and that Canada has an important part to play – and to play quite soon – in research in "near space", and

(4) With regard to the mechanics of Institute meetings:

(a) Every programme should include a predominance of fairly narrow and specific papers, with relatively few of the rather broad and shallow "general interest" variety, and

(b) Concurrent sessions are undesirable; they may enable more ground to be covered in a two-day programme but the diversity of interests in Canada at the present time is not sufficient to justify such dilution of the programme.

ADVANCE PLANNING

To improve the Committee's contact with the Branches, the President was asked to appoint the Chairmen of all the Branches to serve on the Committee; this he had done and, thus fortified, the Committee has turned its attention to the future. The Committee's experience this year has emphasized the cardinal importance of advance planning; in fact it is not too much to say that the programme for any year – at both the Branch and Institute levels – must be planned, tentatively perhaps but in some detail, by the Committee of the preceding year.

Accordingly this Committee has already arranged for a speaker to tour all the small Branches in November and December next; the dates are firm and the Branches are now engaged in planning the remainder of their pre-Christmas programmes around these dates. In addition, tentative arrangements have been made for a speaker to tour these Branches in March 1961.

A programme for the IAS/CAI Meeting next October has been drawn up in detail and submitted to the IAS. The Canadian speakers on this programme have already been invited.

It is recognized that the best laid plans gang aft agley, but, if only 50% of this advance planning holds, it will be much easier to patch up the remaining 50% at short notice than to patch up the whole thing; which has often been necessary in the past. Besides, a long range plan provides a framework on which to base other plans for Branch meetings, Specialist Section symposia and even the issues of the Journal.

ENCOURAGEMENT OF SPEAKERS

Finally, the Committee must report that it has asked the Branches to do all in their power to develop local talent and to encourage their members to prepare papers for delivery at their own meetings, at the meetings of other Branches and at Institute meetings. There is no doubt that the talent exists; Canadian engineers are doing things every day, learning things, discovering things and putting their ideas into practice; but it seldom seems to occur to them to seek the professional recognition that comes from talking about them.

This point is mentioned last in order to emphasize that those responsible for planning the Branch and Institute programmes are dependent, in the final analysis, on the material available. This material exists and must be found.

COMING EVENTS

IAS/CAI

17th-18th October — *Annual Joint IAS/CAI Meeting*, QUEEN ELIZABETH HOTEL, MONTREAL.

SAE

9th-13th January, 1961 — *International Congress and Exposition of Automotive Engineering*, DETROIT, MICHIGAN.

CAI

27th-28th February, 1961 — *Mid-season Meeting*, WINNIPEG, MAN.

SECTIONS

Astronautics

20th-21st October—*Canadian High Altitude Research Symposium*, CHATEAU LAURIER, OTTAWA.

Test Pilots

18th-19th November — *Symposium*, RCN AIR STN. SHEARWATER, DARTMOUTH, N.S.

APPOINTMENT NOTICES

The facilities of the Journal are offered free of charge to individual members of the Institute seeking new positions and to Sustaining Member companies wishing to give notice of positions vacant. Notices will be published for two consecutive months and will thereafter be discontinued, unless their reinstatement is specifically requested. A Box No., to which enquiries may be addressed (c/o The Secretary), will be assigned to each notice submitted by an individual.

The Institute reserves the right to decline any notice considered unsuitable for this service or temporarily to withhold publication if circumstances so demand.

Technical Artist: minimum of five years experience in perspective drawing and artwork for publications section of an aircraft repair company. Airbrush experience desirable but not essential.

Good working conditions and generous fringe benefits. Relocation allowance to be discussed with successful applicant.

Send résumé of age, education, experience and salary required to:
Industrial Relations Manager,
P.O. Box 517, Edmonton, Alberta.

BRANCHES

Quebec

Reported by Professor C. I. H. Nicholl

April Meeting

The first technical meeting of the Quebec Branch was held on April 25th at Molson's Brewery. Dr. H. M. McMahon, Chairman of the Branch, welcomed 25 members and their guests and introduced the speaker, Mr. G. S. Taylor, Aircraft Engine Sales Engineer from Rolls-Royce of Canada in Montreal.

The speaker gave an excellent account of the development of the by-pass principle in the Conway series of engines, which are unique in the field in that the by-pass duct is an integral part of the engine. The company claims that for the operating conditions envisaged by airlines during the next decade, the by-pass principle yields better power/weight ratio and lower fuel consumption than any other configuration. Mr. Taylor supported this claim with a wealth of data, much of it of particular interest at the present time because of the introduction of Conway-powered DC-8 aircraft on TCA and CPA routes. The increase in thrust on the type from the RCo.8 at 14,500 lb to the RCo.42 which will be available in December, 1961, and will produce over 20,000 lb at markedly improved sfc, provided a most instructive example of the development possibilities of a configuration which is basically sound. The speaker provided a striking illustration of the importance of refinement in design when he pointed out that an improvement of 1% in engine efficiency could permit an increase of 1000 lb in payload on a 4000 mile stage with one of the new generation of transport aircraft.

After a very lively question period, the speaker was thanked by Professor Nicholl, Secretary of the Branch.

Toronto

Reported by C. F. de Jersey

May Meeting

The Annual General Dinner Meeting, held at the Regency Towers Hotel on the 17th May, was generally considered, by the 99 members attending, the best we have ever experienced.

Dr. J. H. T. Wade, the Branch Chairman, opened the business meeting by reviewing the past season's activities; he then requested Mr. J. Lynch to present the Treasurer's Report, after which he introduced to the audience the Branch Executive for the 1960-61 season.

With the exception of the necessary Treasurer's Report, the Chairman kindly relieved the various Committee Chairmen of their duty in presenting individual reports, since it was felt that they might well be repetitious and therefore tedious for the audience.

After the dining room had been transformed into an auditorium the audience re-assembled and was introduced by Dr. Wade to Mr. F. M. Francis.

Mr. Francis, Senior Project Engineer on the Canadair CL-44 aircraft, attended the University of British Columbia, from whence he held senior positions at Boeing, Canadian Pacific Air Lines and Trans-Canada Air Lines and, in 1955, joined Canadair, where for the last four years has been closely associated with the CL-44 aircraft.

The speaker, supported by an excellent series of coloured slides, opened his informal talk by describing the current variants of the '44, the -6 designated for the RCAF, recognizable by the very large rear cargo door, and the -4 or swing tail model.

Although the CL-44 is a development of the Bristol Britannia, the changes effected by Canadair are so fundamental that it can really be called a North American product.

Examples of these changes lie in the increase in all up weight from 175,000 lb to 205,000 lb, an increase in fuselage length of 22 ft – this in itself being 12.5 ft larger than the Argus aircraft. In addition, to accommodate the North American user requirements, the materials used and the complex systems developed bear little similarity to the Britannia.

The speaker described the installation of the Rolls-Royce Tyne turboprop engines and their De Havilland propellers, dealing at some length with the thrust reversal system utilized with these propellers, which allows full control from positive through negative thrust, permitting pauses during any part of the cycle.

A series of slides showed the many possible configurations to which the aircraft can be adapted, and Mr. Francis explained that conversion from basic aircraft to passenger, stretcher or cargo versions is accommodated by the use of two basic kits.

An idea of the astronomical costs incurred by changes to the aircraft was given by the speaker. As an example, he told of changing the windshield arrangement where not only water tank and bird shot tests required but, of course, considerable retooling with a resultant cost of nearly a million dollars.

The ingenious swing tail utilizes a large double acting jack, two 8 ft long hinges on the starboard side, eight hydraulic locks to take up axial loads and twelve wedge block fittings to compensate for torsion loads, to say nothing of the myriad hydraulic, control and electrical breaks. A mock-up was successfully tested over 1,000 cycles, and at the moment a production type model is undergoing a series of tests involving some 10,000 cycles.

The pallet system for cargo loading was described by Mr. Francis as being able to effect a 62,000 lb payload turnabout within a 45 minute load/unload operation. The ten pallets measuring 10 ft long by 7.5 ft wide give a density loading of 12 lb/cu ft, being, he considered, as good as any available. An ingenious chain and hook arrangement has been embodied for loading these pallets from the ground handling equipment designed for this aircraft. Experience showed that only two men were required to handle an 8,000 lb pallet from the ground to compartment stowage.

Mr. Francis went on to show slides of a number of pallets designed for all manner of differing cargo requirements.

In addition to the huge cargo area served by the pallet system, the CL-44 accommodates cargo within its forward and aft lower compartments, the latter being equipped with an ingenious bin arrangement, using rollers for ease of loading.

Finally the speaker told of the performance required of an aircraft of this type; the ability to takeoff with a 62,800 lb cargo from an 8,000 ft runway, allows this aircraft to use all the world's major commercial airports, and investigations undertaken to date indicate operating costs, allowing for a reasonably high utilization, should better the 4c ton-mile figure quoted for the military aircraft.

Mr. C. H. Bottoms, the new Branch Chairman, thanked Mr. Francis for his excellent paper and before calling the meeting closed, asked for a round of applause for Dr. Wade, the retiring Chairman.

Montreal

Reported by W. H. S. Bird

May Meeting

The Annual Branch Business Meeting was held at the Airlines Restaurant, Montreal, on May 18, 1960; Branch Chairman, Mr. R. F. O. Smith, presiding. 33 attended the dinner with 65 present for the business and lecture sessions.

Following the dinner, Mr. Smith called on Mr. H. H. Whiteman for the Treasurer's Report. Mr. Whiteman quoted figures showing that financially the Branch was in good shape. Mr. R. J. Conrath then outlined the activities of the Students' Section which had included four meetings at McGill University, four at Sir George Williams College and he also mentioned the promotional activities at L'Ecole Polytechnique, Loyola and Collège Royale Militaire.

Mr. Conrath in turn called on Professor Newman to introduce the new Student Executive: Mr. B. R. Thomas (McGill), Chairman; Mr. J. St. Pierre (Ecole Polytechnique), Vice-Chairman; Mr. G. Benzon (Sir George Williams), Secretary; Mr. P. Boeuf (Ecole Polytechnique), Treasurer; Mr. I. Wygnanski (McGill), Mr. C. R. Cousins (Sir George Williams), Representatives.

G/C C. W. Crossland introduced Mr. S. B. Savage who had won the Branch Students' Competition. The prize, presented by Mr. Smith, consisted of a bronze medal, a $50 cheque plus a year's membership in the CAI.

Mr. Smith presented the Chairman's report outlining Branch activities for the year and thanking the Executive and Committee members who had helped to contribute to the success of the year's activities. He then announced the results of the recent elections and introduced the new Executive.

Mr. Smith then handed the gavel over to the incoming Chairman, Mr. D. R. Taylor.

Mr. Taylor called upon Mr. Savage who very ably presented a synopsis of his prize winning paper entitled "The Use of Simple Concepts for the Prediction of Base Pressures Caused by Interaction of a Jet with an External Stream". This proved to be most interesting and of a very high technical standard.

The main speaker of the evening, Captain R. Baker, Flight Test Engineer-Pilot, Trans-Canada Air Lines, was agreeably surprised to find that he was being introduced to the audience by his son, Mr. A. Baker, an engineer with Canadair Limited.

Captain Baker stated that the new big jets were "just another aircraft but with a difference". He outlined the various regulations applying to performance of jet aircraft and demonstrated how they were applied, how necessary long runways were for these new aircraft and how closely the aircraft had to be flown to the correct parameters in order to provide economical and safe operation. Reserve fuel was a problem since the aircraft "required 25% fuel just to carry fuel". Speed, comfort and performance of these new aircraft were outstanding and he quoted one pilot's reaction to the takeoff as "feels like a ball in a sling shot". Among the numerous problems mentioned were weather forecasting inaccuracies and air traffic control decisions which could require uneconomical fuel weight requirements by merely revising flight altitude by a few thousand feet etc.

The lengthy question period indicated the keen interest of many of the audience in Captain Baker's talk and included such questions as to the degree that weight and altitude govern the stability of the aircraft; to which Captain Baker replied that the aircraft was very intolerant of altitude changes; at very heavy weights and in high winds, the aircraft could get into a very limiting Mach condition; it was found that fuel control was best accomplished by setting up the basic parameters, cross-checking on the fuel flow instruments, which were quite accurate, etc. Concerning landing speeds, Captain Baker felt that they were too high – "pilots are always amazed when turning around after landing to see the amount of runway they have used". He personally had felt for years that landing speeds were becoming increasingly too high and now felt that economically, we must turn to some means of slowing down landing speeds.

Mr. F. C. Phillips thanked the speaker for a very complete exposition of the pilot's problems in coping with the tremendous complexities of the jet age and paid high tribute to Captain Baker and his colleagues who interpreted the actual requirements into the form of pilots' notes etc, for the use of the airline flight crews.

Winnipeg

May Meeting

Reported by R. P. Hughes

The May Dinner Meeting of the Branch was held in the Winnipeg Flying Club on Tuesday evening, May 24, 1960, 46 persons attended.

Mr. D. C. Marshall was chairman of the meeting. After the toast to the Queen, Mr. Marshall introduced the head table guests and read off the names of the visitors, extending a welcome to them. He then called on Mr. R. P. Hughes to introduce the speaker.

The speaker for the evening was Dr. P. J. Sandiford, Director of Operations Research, Trans-Canada Air Lines, Montreal.

Dr. Sandiford's topic was "Truths Without Consequences". Dr. Sandiford explained the title by indicating how electronic digital computers, together with a simulation or model of an operating system or business, made it possible for managers to test the probable effects of policy changes, or to establish "truths", without running the risk of financial disaster – "the consequences".

Dr. Sandiford showed how these techniques had been used in TCA to study the flight reservation system and how the choice of a computer to handle this task had been tied in with the effects of varying computer time constants in the model, in order to arrive at an optimum system capability. He also told about a simulation of a stores, overhaul shop and aircraft operating system, and how such a method could be used to assess the effects of varying the number of spare units on station allotment, on the number of delays occurring at that station and the effect of this on the system as a whole.

There are pitfalls in the use of simulation techniques, since the answers obtained from the computer are qualified "truths" as they represent the effect of changes on the model, and are only valid if the model simulates the real system accurately. However, in many simulations "good enough" answers can be obtained and the effect of changes on a system can be assessed.

No computer can predict the future.

The speaker showed a computer tape, which represented 90 minutes of computer time and corresponded with five years of system operation.

A very lively question period followed Dr. Sandiford's talk, indicating the interest of the meeting in the use of these simulation techniques.

Mr. J. G. Davidson thanked the speaker on behalf of the meeting for his very interesting talk.

June Meeting

Reported by C. P. Gulland

The fourth Annual General Meeting of the Branch was held in the Albany Room of the Assiniboine Hotel, St. James, on June 23. This year printed reports of the various Committee Chairmen were introduced. This innovation was gratefully accepted by the membership.

Following the dinner, Acting Chairman W/C J. C. Evans, called a recess and requested that the reports be read during that period and explained that questions would be answered by the

Chairman responsible. On resumption of the meeting, W/C Evans turned the meeting over to the incoming Chairman, W/C Evans. With this bit of by-play out of the way the Chairman called on Mr. M. Auld to introduce the speaker of the evening, Mr. K. R. Patrick. Mr. Auld traced the speaker's background from his birthplace in St. John, N.B., through his various assignments in the RCAF, RCA Victor and Canadian Aviation Electronics to his present position of Chairman of the Board of Canadian Vertol, a subsidiary of the Boeing Company.

Mr. Patrick entitled his paper "Vertical Flight, A New Dimension for Canada" and in his opening remarks expanded this as follows: "I will deal today with a concept, the concept of vertical flight and what I think it can do for Canada in general and for Canada's aviation industry". With this objective in mind, the speaker proceeded to show that a concerted effort on the part of government and industry to develop the helicopter would be a tremendous asset to Canada.

Mr. Patrick visualized in the helicopter an article for defence and of commercial use. In addition to the transport of passengers, properly developed this new Canadian product would be of value in the following ways:

(1) It would support the employment of a wide range and variety of skills,

(2) be useable as an instrument in the opening up of Canadian resources, and

(3) be exportable to military and non-military users.

The speaker expressed the belief that the cost of government aid in helicopter development would be repaid in even more ways than those listed above, e.g. gaining a differential advantage in technological development or production know-how over other countries. At the same time he warned that this opportunity would be short-lived, as other countries appeared interested in the development of this type of aircraft.

The development costs were said to be extremely low and an example was cited of a 25 seat turbine powered helicopter which cost less than eight million dollars to design.

The history of helicopters was covered briefly to show the advances made since 1924, when the record distance of 360 meters was established in France, to November 29, 1959, when a Russian M16 helicopter set an unofficial average speed record of 167.1 mph over a 60 mile circuit and climbed to 20,900 ft with an 11,023 lb pay load.

The speaker gave an outline of his company's aircraft, the Vertol 107. It has beaten the speed record of the M16, one-engine-out performance is excellent, it carries 25 passengers, has hovering ability with full load, flew from Parliament Hill, Ottawa, to the Sun Life Building, Montreal, in 44 minutes and 53 seconds, equivalent to 39 minutes with zero head wind.

Many interesting facts were mentioned in the paper, the following are some examples. It is estimated that over 10,000 purchases of helicopters will be made in the USA by 1965, 6,200 for civilian use. The per capita use of commercial helicopters in Canada is roughly three times that of the USA. The external noise level of the Vertol 107 at 500 ft is equal roughly to that of an automobile at 20 ft, and the internal noise level is comparable with a Viscount.

The question period following Mr. Patrick's paper covered many points of helicopter operation. Traffic control and operating costs appeared to be the main areas of interest.

Mr. D. C. Marshall thanked the speaker for his interesting and well delivered speech. W/C Evans closed the meeting with some comments on the advances seen in aviation during the past year.

SECTIONS

TEST PILOTS

SETP Publications

The Council has approved a scheme, put forward by the Executive Committee of the Section, whereby a limited number of subscriptions to the Quarterly Review of the Society of Experimental Test Pilots will be made available to members of the Test Pilots Section at half price, namely $2.50 per annum. This yearly subscription includes 12 issues of the SETP Monthly Newsletter, as well as the 4 issues of the Quarterly Review.

Any member of the Section wishing to avail himself of this scheme should send his order to the Secretary C.A.I., 77 Metcalfe St., Ottawa, together with a remittance of $2.50. Cheques should be made payable to the Canadian Aeronautical Institute.

ASTRONAUTICS

Annual Report of the Executive Committee 1959-60

The Astronautics Section has now finished its second year of existence. The most important and urgent task of this year was seen in the consolidation of the Section in particular regarding local activities, to promote interest in Canada in the field of astronautics and to forward Canada's active participation in upper atmosphere research and astronautics in general.

Membership

Starting with 41 members when the Section came officially into being in October 1958, the membership increased to 80 during the first year. The present membership is 92, geographically located as follows:

Montreal 30, Ottawa 29, Toronto 17, Quebec 3, Cold Lake 1, Winnipeg 1, Vancouver 1, USA 8, England 2.

Executive Meeting

The Executive Committee of the Section met on the following dates:

July 16, 1959 – Ottawa
October 14, 1959 – Ottawa
December 7, 1959 – Ottawa
March 21, 1960 – Ottawa
May 24, 1960 – Ottawa.

Section Meetings

October 15 and 16, 1959
UTIA Toronto

Within the program of the Institute of Aerophysics, University of Toronto, Decennial Symposium in October 1959, two technical sessions on astronautical subjects were sponsored by the Astronautics Section. The following papers were delivered at this meeting:

Dr. P. Savic – The Blast Wave from an Impulsively Generated and Driven Plasma

Dr. E. Bendor – Consideration in the Design and Operation of High Altitude Research Vehicles

Prof. B. Etkin – Stability of a Lifting Vehicle in a Circular Orbit at less than Satellite Speed

Dr. J. C. Evvard – The Urge Toward Space Conquest

Dr. H. Preston-Thomas – Plasma Propulsion for Space Vehicles

Dr. W. J. Heikkila – Radio Tracking and Communication Methods for Space Vehicles

February 19, 1960

Mid-season Meeting, Edmonton

The Afternoon Session of the Mid-season Meeting was devoted to astronautics. The session opened up with two films, "X minus 80 days" and "Widest Horizons", and continued with the following two lectures:

Dr. J. L. Locke – Space Astronomy
D. K. Breaux and R. L. Schultz – Non-Propulsion Power Systems for Missiles and Space Vehicles

May 24, 1960

CAI Annual General Meeting, Ottawa

The morning session of the Meeting was entitled "Man in Space", with two papers as follows:

Mr. K. J. Radford – Future Uses of Space Vehicles
W/C R. A. Stubbs – Some Engineering Considerations for the Manned Space Vehicle

The Symposium on High Altitude Research

Originally planned for last year, the Symposium could not take place since it was the general feeling that, with regard to the Canadian Research Program, a later date would be more opportune. The Symposium has been postponed to October 1960, and all preparations are well under way.

Local Activities

It is evident that the main efforts in Section activities must be centered in the local units. It is one of the aims of the Astronautics Section to further local activities and to encourage the formation of Groups. This was successfully achieved in Montreal where monthly discussion and lecture evenings are being held.

(i) *Montreal*

Group Meetings

The Group had its first Discussion Evening in November and from February on, with the second Discussion Evening, has had meetings the second Tuesday in every month. The Group convened on five evenings with discussions and lectures on dispersion, orbital mechanics, guidance and control problems, the planets of the solar system and properties of the upper atmosphere.

Branch Meetings

A Montreal Branch astronautics meeting was held on November 18th, 1959, with a lecture by Dr. M. B. T. George, AVCO, on re-entry problems.

A second Branch meeting took place on February 23, 1960, when Dr. G. H. de Vaucouleurs of Harvard College Observatory gave a lecture on the "Atmospheres of Venus and Mars".

(ii) *Ottawa*

Branch Meetings

On December 10, 1959, the Branch was addressed by Dr. H. F. York on the US Program for Development of Rockets for Ballistic Missiles and Space Exploration.

On February 24, 1960, the Branch was addressed by Dr. de Vaucouleurs, who had spoken at the Montreal Branch the evening before.

(iii) *Toronto*

No direct astronautics activities within the Branch.

Newsletters and Astronautics Notes

The Section has decided to issue Newsletters, to inform the members of the Section of all activities on the national scene and in the local Groups. So far two Newsletters have been issued, the first in January 1960, and the second in April. The Newsletters which are distributed among the members, are also published in the CANADIAN AERONAUTICAL JOURNAL.

In addition, a series of Astronautics Notes has been introduced which intend to report on Branch lectures, Group discussion evenings and topics of interest to the Section. These Astronautics Notes are being sent to all members but will at present not be published in the CANADIAN AERONAUTICAL JOURNAL.

Treasurer's Report

Credit at the beginning of the year	$25.00
Expenses (Postage)	5.12
Credit at the end of year	19.88

The incoming Executive will receive an additional amount of $25.00.

Executive Committees

(i) *Retiring Committee*

Mr. D. Bogdanoff, Chairman
Dr. H. J. Luckert, Vice-Chairman
Dr. D. G. Gould, Secretary-Treasurer
Dr. H. S. Ribner, Past Chairman

(ii) *Incoming Committee*

Dr. P. M. Millman, Chairman
Prof. G. S. Glinski, Vice-Chairman
Mr. J. G. LaBerge, Secretary-Treasurer
Mr. D. Bogdanoff, Past Chairman

Appreciation

Special thanks are due to the Secretary of the CAI, Mr. H. C. Luttman, for his continuous interest, advice and encouragement regarding the Section's affairs. His steady and stimulating help contributed, in no small degree, to the progress of the Section's activities.

MAN-POWERED FLIGHT

Though not yet qualifying as a Section, the Man-powered Flight Committee will report progress under this heading.

The Secretary's Letter in the May issue drew attention to the Kremer Competition established in England and reported on the self-appointment of a Committee to keep in touch with developments here. The appointment of this Committee has since been approved by the Council. The Committee met in June and made several important decisions.

Objective

Firstly it expressed its objectives as follows: "To stimulate interest in and work on man-powered flight in Canada". It should be noted that it made no reference to the Kremer Competition, which is felt to be beyond the immediate goal of the Committee. There is a good deal of educational work to be done first.

Library and Collection

Secondly it decided to establish a library and collection of photographs and other items associated with the subject. This library will be set up at CAI Headquarters and members are invited to make use of it. A list of the books and papers in it will be published shortly. It is hoped, too, that anyone having any books, articles, sketches or other material bearing on man-powered flight will present them to the Institute for this collection.

Programme

Thirdly the Committee selected a number of potential authors who will be invited to contribute papers on various aspects of the subject, such as low-density structures, low-speed aerodynamics and boundary layer control, propellers, ornithopters perhaps and ergonomics. These papers, if they can be obtained, will be published in the Journal during the coming months, as a build-up to a symposium on man-powered flight tentatively planned for next May.

In addition the Committee will try to arrange for one or two speakers for this season's Branch programmes.

At the symposium in May, it will be time to decide on the next step.

MEMBERS

NEWS

Winnett Boyd, F.C.A.I., has been named President of the newly established Arthur D. Little of Canada Ltd., Toronto.

J. T. Dyment, F.C.A.I., has been elected to the Board of Directors of the Society of Automotive Engineers.

B. S. Shenstone, F.C.A.I., has recently been elected a Vice-President of the Royal Aeronautical Society.

J. W. Ames, A.F.C.A.I., has been appointed Vice-President and General Manager of Canadian Applied Research Ltd.

A/C R. H. Bray, A.F.C.A.I., has been appointed Chief of Aeronautical Engineering at AFHQ.

G/C A. A. Buchanan, A.F.C.A.I., has been appointed Director of Instrument and Electrical Engineering at AFHQ.

Prof. A. R. Collar, A.F.C.A.I., has been elected a Vice-President of the Royal Aeronautical Society.

A. C. Earle, A.F.C.A.I., General Manager of the Fairey Aviation Company of Canuada Limited, has been elected to the Board of Directors.

S. E. Harper, A.F.C.A.I., has accepted a position with Atomic Energy of Canada Ltd. as Materials Engineer.

G/C D. M. Holman, A.F.C.A.I., has been appointed Deputy Chief Logistics Div., AMC HQ, RCAF Stn. Rockcliffe.

CDR E. B. Morris, A.F.C.A.I., has left RCN Air Station Shearwater, to take up the appointment of Director of Aircraft Engineering, RCN Headquarters.

G/C A. F. Avant, M.C.A.I., has recently been appointed Commandant of the Canadian Services College, Royal Roads.

C. Campbell, M.C.A.I., has been appointed Factory Manager for Purolator Products (Canada) Ltd.

J. McLachlan, M.C.A.I., formerly with Orenda Engines Ltd. has recently taken a position with Rolls-Royce of Canada Ltd. as a Service Representative.

G. J. Palmer, M.C.A.I., formerly with Avro Aircraft Ltd. has been appointed to the position of Vice-President and Technical Director of Magwood Associates Ltd.

J. A. Murray, Technical Member, has returned from Indonesia, where he was with the ICAO Technical Assistance Mission, to take up the position of Technical Representative for Collins Radio Co.

DEATH

It is with deep regret that we record the death of two Honorary Fellows; **Mr. W. F. English,** formerly Vice-President, Operations, Trans-Canada Air Lines, died on the 12th May; and **A/V/M A. T. N. Cowley,** who, at the time of his death on the 7th July, 1960, was West Coast Consultant for the De Havilland Aircraft of Canada Ltd.

OBITUARY

Air Vice Marshal A. T. N. Cowley

A/V/M A. T. N. Cowley, fondly known as "Tom" to the aviation fraternity, died at Victoria on July 7th, 1960, after a lengthy illness.

Tom was 71 years of age and a well known and well liked pioneer of Canadian aviation. At the time of his death, he was living in retirement in Victoria. To keep in touch with aviation matters, he acted as West Coast Consultant for the DeHavilland Aircraft of Canada Ltd.

Tom's first contact with aviation came in 1915 when he joined and served with the RNAS and in 1918, when the RNAS and the RFC amalgamated, he became a member of the RAF.

In 1922, Tom enlisted in the newly formed Canadian Air Force and served continuously until 1945 when he retired with the rank of Air Vice Marshal. Before and during World War II, he held important posts in the RCAF as Director of Manning, AOC No. 4 Training Command, Air Member for Organization at Ottawa and AOC No. 1 Training Command.

In 1946, he was appointed Director of Air Services in the Department of Transport, a position which he held until his retirement in 1954.

During peace and war, in both civil and military aviation, Tom lived the life of an airman, was qualified in 174 different types of aircraft, and knew virtually all the pilots of his flying days by their first names. His interest in Canadian aviation and those of us who were priviliged to seek his counsel, has left an endeared memory that will last our lifetimes.

G. C. V. HURREN

ADMISSIONS

At a meeting of the Admissions Committee, held on the 12th July, 1960, the following were admitted to the grades shown.

Associate Fellow

J. C. M. Frost, Chief Design Engineer VTOL, Avro Aircraft Ltd., Malton, Ont.: *35 McIntyre Crescent, Georgetown, Ont.*

Member

Dr. A. R. Barringer, Manager, Airborne & Technical Services Div., Selco Exploration Co. Ltd., 145 Belfield Rd., Rexdale, Ont.

C. H. Butt, Service Representative, Bristol Aircraft Ltd., Bristol, England: *Bristol Aero-Industries Ltd., Vancouver Airport, B.C.*

B. D. Darling, Sales Engineer, Garrett Manufacturing Ltd., Rexdale, Ont.: *801, 77 Metcalfe St., Ottawa 4, Ont.*

LCDR. S. W. Grossmith, RCN, Test Pilot, Experimental Squadron 10, Shearwater, N.S.: *24 Clearview Crescent, Dartmouth, N.S.*

S. R. Gwilt, Designer, Structures Laboratory, National Aeronautical Establishment, Ottawa, Ont.

P. Hollenberg, Performance Engineer, Canadian Pacific Air Lines, Vancouver, B.C.: *1620 Haro St., Apt. 206, Vancouver 5, B.C.*

F/L W. F. Longley, RCAF, Engineering Officer, 402 Squadron (Auxiliary), RCAF Station, Winnipeg, Man.: *440 Whytewold Rd., St. James, Man.*

J. Maskell, Repair & Overhaul Project Coordinator, Service Dept., Canadair Ltd., Montreal, P.Q.: *250 St. Louis Ave., Dorval, P.Q.*

LCDR. L. M. Patterson, RCN, Industrial Procedures Analyst, Naval Comptroller's Dept., Ottawa, Ont.: *Wardroom, RCN Air Station Shearwater, N.S.*

L. G. Wigle, Director of Marketing, Field Aviation Co. Ltd., Oshawa, Ont.: *315 Holmwood Ave., Apt. 507, Ottawa, Ont.*

Technical Member

M. J. Bobrik, Technician, De Havilland Aircraft of Canada Ltd., Downsview, Ont.: *427 Walmer Rd., Toronto 10, Ont.*

L. S. Erickson, Sub-Foreman (Electrical), Pacific Western Airlines, Edmonton, Alta.: *11712-139th St., Edmonton, Alta.*

J. J. Grobler, Field Service Representative, Aviation Electric Ltd., Montreal, P.Q.: *5575 Jeanne St., Apt. 5, Montreal 9, P.Q.*

T. Wells, Quality Control Technician, Orenda Engines Ltd., Malton, Ont.: *367 Caledonia Rd., Toronto 10, Ont.*

Junior Member

W. J. Boudreau, Engineering Assistant, Canadair Ltd., Montreal, P.Q.: *7431 Stuart Ave., Montreal, P.Q.*

Associate

W. L. Farrington, Contracts Administrator, Bristol Aero-Industries Ltd., Montreal, P.Q.: *5545 Albert Duquesne St., Montreal North, P.Q.*

BOOKS

Advanced Propulsion Systems. Edited by M. Alperin and G. P. Sutton. Pergamon Press Inc., 1959, 237 pages. Illus. $6.00.

A classified symposium on Advanced Propulsion Systems was held in Los Angeles in December 1957, jointly sponsored by the Air Research & Development Command of the USAF and by the Rocketdyne Division of North American Aviation. This book is a collection of those papers that have since been declassified. The subject matter of the papers range from logistic considerations of conventional liquid fuels, through the possibilities of metals and their hydrides, free radicles, plasma jets, ion propulsion, magnetohydrodynamics, solar furnaces boiling liquid hydrogen, to the ultimate objective of achieving speeds which are a significant fraction of the speed of light by nuclear fusion. The majority of the papers deal with space propulsion, but one of them is on the use of nuclear energy in air-breathing engines.

As is inevitable with a symposium such as this, the papers are not a systematic expansion of a theme but rather a series of disconnected papers, varying from mathematical analysis of a system to chatty discussion of a topic. The eighteen papers also vary in length from three pages to thirty-four. It would appear that, in the declassification process, some papers have been censored to the extent that the remaining content hardly justifies publication. For example, one paper says little more than, "Magnetohydrodynamics could be a good thing".

The final paper reflects on the probability of intelligent life, capable of the development of inter-stellar travel, existing within shooting distance of our solar system, and, with the question "Where is everybody?" wonders why we have not had visitors yet. Perhaps the answer is contained in the first paper, where the author considers propulsion achieved by the detonation of one-megaton hydrogen bombs at machine gun speed of 600 firings per minute.

F. H. Keast

Selected Topics on Ballistics. Edited by W. C. Nelson. AGARD publication, Pergamon Press Inc., New York, 1959. 280 pages. Illus. $9.00.

This volume includes the papers read at the Cranz Centenary Colloquium held in West Germany and the discussions which followed them.

Taken as a whole, the volume cannot be considered as anything but mediocre, embracing considerable generalized and out-dated trivia with but few exceptions. The subject matter gathered under the title ballistics is rather surprising along with the flyleaf's claim that the world's leading specialists are expounding in these fields. After a brief bit of history, the reader is taken through a treatise on aerodynamic effects on long range rocket craft, which covers briefly aerodynamic loading and heating effects on re-entry vehicles and includes discussions on the recovery of artificial satellites and space-craft, along with deceleration aspects of human habitation of such objects. This is followed by two papers on Explorer 1, the first purposing to cover the ballistic aspects, while the second covers the launching of that vehicle. The ballistic aspects of Explorer 1 are considered to reduce solely to the variation in total impulse in the high-speed phases of the launching, and various contributing factors are assessed for this case. The launching of the vehicle is covered in a descriptive manner complete with leaving-the-pad photographs.

Following the launching of Explorer, one of the more interesting papers of the volume is presented reviewing some aspects of meteorites of direct interest to the re-entry problem; these include ablation and impact effects, and the reader cannot help but be impressed by the obvious voids in knowledge.

Following this, a paper on theoretical aerodynamics is presented covering a brief but competent review of supersonic flow past wing-body combinations, including such subjects as linearized steady flows, slender body approximations, the area rule, wing-body interference, and non-linear, non-steady flow solutions. Following this, the stability and damping of spin stabilized projectiles is treated; as pointed out in the discussion following this paper, the basic assumption of neglecting the Magnus moment renders the theory questionable and in contradiction to the well-known results of recent work on this continent.

Following this, papers are presented covering the stability and controllability of cross-winged guided missiles, the role of free-flight ranges in ballistic and aerodynamic research (a rather comprehensive review up to the time of the colloquium), electronic and optical means of observation of guided missiles and satellites, special ballistic ranges and gas guns (a somewhat disappointing résumé), preliminary planning for a hypervelocity range at AEDC (a surprising subject for permanent record in a bound volume), forty years of British Internal Ballistic Research, a brief history of rocket research and development in the United Kingdom, secondary flow effects on self-propelled jet engines and, finally, scaling problems in underwater ballistics.

The papers with but few exceptions fail to establish a reasonable technical standard nor does the volume as a whole portray the current status of ballistic research. The reader gathers the impression of a broad-brush treatment by touring senior statesmen, and, by glancing for comparison purposes at the contents of the journals of various national technical societies in the fields of combustion, space technology, aeronautics etc, one can find far more comprehensive and meaningful treatment of the same subjects. This reviewer could not recommend this volume for other than decorative purposes.

Dr. G. V. Bull

Proceedings of the Fourth Midwestern Conference on Solid Mechanics. University of Texas, 1959, 530 pages. Illus. $12.50.

This volume represents the proceedings of the Fourth Midwestern Conference on Solid Mechanics which was held at the University of Texas on September 9-11, 1959. The wide field which is covered by the heading of Solid Mechanics can result in a large number of papers being submitted for presentation, and in this book, no fewer than twenty-nine are given, representing a busy three days. The list of authors is impressive and each of the papers is a worthy contribution to the state of the art.

Five main subject groups, all connected to structural analysis, appear to have dominated the meeting.

Shell Analysis (papers 1, 4, 7, 10 and 11). A very interesting review of general shell theory, which should be of interest to layman and specialist alike, introduces the subject. This is followed by a paper on shell vibration and by a study of the collapse load of a spherical cap. It is shown in the remaining two

papers how the difficult problem of conical shells under asymmetric loads can be solved by either numerical or analytical methods.

Elasticity (papers 5, 6, 8 and 9). A study of crack propagation and fracture arrest by riveted stiffeners is followed by a report on the bending and buckling of laminated plates, both of which have obvious design applications. The pattern of stress in a square plate with a central pressurized hole is investigated by a test study, and the final report is on elastic discontinuities in ring plates. (i.e. spring washers).

Thermal Stress (papers 12, 13, 14, 15 and 16). Large deflection of heated plates, vibrations of heated plates, effect of camber on thermal stresses of cantilever plates, optimum design of heated sandwich panels, and structural cross radiation in a leading edge structure represent the particular subjects investigated. Of particular interest is the result of the study of the effect of camber on thermal stresses. The conclusion is that an approximation of cambered lifting surfaces by flat plates, for the purpose of thermal stress analysis, is not a good approximation even for the case of small camber.

Impact (papers 2, 3, 17, 18, 19, 20, 21 and 23). The related problems of steel plate response to underwater explosions, wave pattern due to a plane dislocation moving in an elastic medium and longitudinal impact of rods are well documented. In addition to theoretical reports, there are also reports describing experimental techniques suitable for these studies and their results. As an example, the test method for evaluating the effect of strain-rate and elastic moduli is described. This set of results shows the manner in which the ultimate stress increases whilst the effective modulus of aluminum and copper decreases with strain-rate.

Vibration (papers 22, 24, 25, 26 and 27). The investigation of transverse wave propagation in a solid elastic mass contained in a long rigid tank is discussed. The problem of the dynamic behaviour of solid propellant motors is also briefly treated. Other reports deal more directly with vibrations (i.e. frequencies of sandwich beams, bending waves in free-free beams, damping of vibrations by alternate visco-elastic layers, as well as structural earthquake response).

The two remaining papers deal with a finite integral transform technique and with the spin dynamics of a thrusting rocket in a vacuum. Judging by the number of papers in each category, it is interesting to note the emphasis placed on impact problems, probably as a result of the increased interest in submarine construction. Nevertheless, other subjects are also well presented and the book should be of great interest to scientists and research engineers in a wide range of engineering fields.

J. A. McKillop

Fluid Control Power. Edited by J. F. Blackburn, G. Reethof and J. L. Shearer. John Wiley & Sons, New York, 1960. 710 pages. Illus. $17.50.

This book results from work undertaken at the Massachusetts Institute of Technology beginning in 1939 in the Servo-mechanisms Laboratory and continuing from 1945 in the Dynamic Analysis and Control Laboratory. It is, in effect, a summary of the experimental and analytical efforts of a relatively large group of staff and graduate students in the field of fluid (gaseous and liquid) control of a wide range of mechanisms ranging from machine tools to guided weapons. Most of the book has previously been published as notes covering a series of lectures presented to groups of industrial representatives attending special summer courses held at MIT. A total of eleven contributing authors and three editors are listed and the support of numerous other staff members and government and industrial organizations is acknowledged.

One might conclude from the facts quoted above that the result would be a rather uneven collection of data and, in fact, the preface by the editors does apologize for such resulting minor shortcomings as the inconsistency of notation. On the whole, however, this book should be well received by those who are involved in the exacting, and often frustrating, business of employing fluids for the conversion, transmission and control of power.

The reader is assumed to have a good basic knowledge of hydrodynamics or as it is now generally called "fluid mechanics" and the book commences with three chapters reviewing this subject without expending the space necessary to develop the formulae presented. This is followed by eight chapters. The heart of the book, devoted to the theory and practice of hydraulic control components with particular emphasis on valves. The remaining nine chapters deal with the dynamic analysis of systems and describes recent progress with systems employing gaseous media, especially high-pressure air, which are becoming increasingly popular in the missile and space field.

Physically, the book is an excellent example of the printing art, consisting, as it does, of over 700 pages on slick paper with very good reproduction of photographs, symbols, figures and tables and including an extensive index and frequent references throughout the text.

G. F. W. McCaffrey

The Theory of Space, Time and Gravitation. By V. Fock, Pergamon Press, New York, 1959, 425 pages. Illus. $15.00.

The "Theory of Space, Time and Gravitation", by V. Fock of the Physical Institute of Leningrad University, was originally published in Moscow in 1955. It has now been translated by Prof. N. Kemmer, FRS, of the Tait Institute of Mathematical Physics at the University of Edinburgh. Only a few minor changes have been incorporated in this new English edition by the Pergamon Press.

The author intended this work to serve first as a textbook on the theories of relativity and gravitation; second, to describe his own original researches on these subjects and, third, to put forward some unorthodox views on Einstein's General Theory of Relativity, which he refers to rather as Einstein's Theory of Gravitation. This volume is certainly a very good textbook, particularly in the earlier chapters where Einstein's "Special" Theory of Relativity is covered (the author prefers to omit the adjective). His own contributions too have added a great deal to the logical development of his subject. Of particular interest however, is the author's view that Einstein did not properly understand the fundamental basis for his own General Theory of Relativity. Parenthetically, perhaps this is why it is difficult for a mere layman to understand it at all.

This is not the place to discuss abstruse problems, and certainly this reviewer is not going to stick his neck out one way or the other. Suffice it to say that the author presents a strong case for his belief that there is less true relativity in Einstein's General Theory than in his Special Theory, and that Einstein put too little emphasis on the importance of the properties of space as a whole, particularly of the conditions "at infinity". May I recommend to interested parties that they consult the book itself. Certainly the last word on this subject has not yet been heard.

In addition to finding some simple typographical errors on pages xvii, 100 and 167 your reviewer also spotted a short paragraph explaining that a study of Lenin's "Materialism and Empiro-criticism" had been particularly helpful in forming the author's philosophical approach to Einstein's theories.

W. F. Campbell

Physics and Medicine of the Atmosphere and Space. Editors: Otis O. Benson, Jr. and Hubertus Strughold. The Proceedings of the Second International Symposium, at San Antonio, Texas, Nov. 10, 11, 12, 1958. John Wiley and Sons, Inc., 1960. 645 pages. Illus. $12.50.

This volume, like its predecessor ("Physcis and Medicine of the Upper Atmosphere", 1952, U. of New Mexico Press), is an invaluable collection of papers by foremost authorities. While it is not entirely free of unscientific speculation, it is probably the most useful up-to-date collection of data and opinions on this subject.

It should prove a uniquely valuable reference source for those seeking more information than is available from articles in popular and semi-technical journals. For example, Van Allen's chapter "On the Radiation Hazards of Space Flight" is an excellent appraisal of the current state of knowledge; F. L. Whipple outlines the sources of information and nature of our knowledge concerning meteoritic material in space, and provides suggestions for further scientific studies; L. R. Shepherd presents a comprehensive survey of possible propulsion systems; R. M. Stanley, K. Ehricke, Norman Petersen, and Alfred Mayo propose in some detail means whereby rescue from space vehicles can be achieved; G. P. Kuipera has a short, readable chapter on the environments of the moon and planets; human tolerance from accelerations of space flight is presented by Col. Stapp in a masterly condensation of the large body of available knowledge; the complicated problems connected with nutrition for long space voyages are presented by R. G. Tischer; H. Strughold and G. P. Sutton discuss interplanetary travel from the viewpoints of physician and engineer, respectively.

As may be inferred from this sampling of the forty-two chapters, the book holds interest for many disciplines; the engineers, chemists, astronomers, biologists, physiologists, will each find much of interest. The bibliographies at the end of each chapter make this a valuable reference book.

The book is recommended as essential for general technical libraries. For those who are working in the field it should be required reading.

Dr. M. G. Whillans

Mechanics of Materials. By A. Higdon, E. H. Ohlsen and W. R. Stiles, John Wiley & Sons, New York, 1960. 502 pages. Illus. $7.75.

This 502-page text, 30 pages of which contain tables, answers and index, is the joint effort of three authors with widely varying backgrounds and, as indicated in the preface, is "a suitable first mechanics of materials text". Suggested pre-requisites for an understanding of the contents of this book are courses in statics, calculus and physics.

Throughout the text the use of free body diagrams is stressed. Furthermore, rather than derive a great number of equations each suitable for the solution of one particular type of problem, the authors have concentrated on conditioning the student to approach each problem using the fundamental laws of mechanics and a logical, orderly method of procedure.

The first three chapters deal with the three types of loading – centric, torsional and flexural – and the stresses resulting from them. A departure from the normal order of presentation is that the topics "principal stresses" and "the Mohr circle" are introduced in the first chapter and discussed more completely in a later chapter dealing with combined loading. Chapter 4 deals with the deflections caused by flexural loading using the two standard methods – integration and moment-area. The reader is also reminded that the principle of superposition, as introduced earlier for the solution of combined load problems, may be used to advantage in the solution of some deflection problems. Statically indeterminate beams are dealt with in Chapter 5, the necessary groundwork for obtaining the deflection of the beam having been covered in the previous chapter. Four methods of elastic analysis and one method of plastic analysis are developed. Combinations of the three basic types of loading as they relate to the resultant stresses and strains are investigated, and at the end of the chapter some of the more common theories of failure such as the Rankine, maximum normal strain, maximum shearing stress and maximum distortion energy theories are discussed. Chapter 7 deals in a standard manner with columns, introducing columns loaded in the plastic range which are discussed at the end of the chapter. The behaviour of metals under repeated loading is the heading for Chapter 8, and it ends with some empirical data on stress concentration factors. Chapter 9 deals with dynamic loading and the concepts of strain energy and resistance to failure. The final chapter deals with connections, both riveted and welded, although the latter receives rather brief coverage.

The illustrations and diagrams are excellent, much use being made of halftoning, shading and sectioning. There are only a few photographic illustrations but they are of current engineering interest. For example those in Chapter 8 illustrating fatigue failures in gas turbine blading serve to remind the student that the mastering of the contents of this book is one step along the road to becoming an engineer. A great effort has been made to place each figure on the same page as the written material which refers to it; this arrangement speeds up the reading and absorption of the subject matter. The method of placing the examples at the end of each section within the chapter should appeal both to student and instructor.

At this level of the subject it is difficult to present the material in an entirely new manner; however, where possible, the authors have drawn on their teaching experience to make the coverage as digestible as possible.

A. R. G. Leckie

Hypersonic Flow. Edited by A. R. Collar and J. Tinkler, Butterworth Scientific Publications, London, 1960. 432 pages. Illus. $13.50.

The above volume consists of 15 papers and their respective discussions. They form the Proceedings of the Eleventh Symposium of the Colston Research Society held in the University of Bristol. For those readers who are not familiar with the Colston Symposia, it is worth noting that they are promoted by the Society in support of original work in the University of Bristol. Since 1948, their subject matter has ranged from cosmic radiation, engineering structures, colonial administration, physiology, the theatre, to the present topic. The Society is to be commended for their present topical and important choice.

A list of the papers and their authors will soon reveal the variety, range, and scope of subjects associated with the rapidly developing field of hypersonic flow. These are listed below as they appear in the table of contents: B. D. Henshall – Experimental Results from the N.P.L. Hypersonic Shock Tunnel; R. K. Lobb – Hypersonic Research at the Naval Ordnance Laboratory; K. N. C. Bray, L. Pennelegion and R. A. East – Performance Studies for the University of Southampton Hypersonic Gun Tunnel; R. N. Cox – Recent Hyperballistics Research at ARDE – The ARDE Gun Tunnels and Some Experimental Studies of Hypersonic Flow; D. A. Spence and B. A. Woods – Boundary Layer and Combustion Effects in Shock Tube Flows; J. W. Miles – Unsteady Flow at Hypersonic Speeds; H. Oertel – Hypersonic Research at the LRSL, Saint-Louis; K. W. Mangler – The Calculation of the Flow Field between a Blunt Body and the Bow Wave; M. D. Van Dyke – Some Numerical Solutions in Hypersonic Flow; J. P. Guiraud – Newtonian Flow over a Surface – Theory and Applications; D. L.

Schultz – Shock Tube Research at the National Physical Laboratory on the Properties of Gases at High Temperatures. Part I, Ionization Measurements: K. C. Lapworth – Shock Tube Research at the National Physical Laboratory on the Properties of Gases at High Temperatures. Part II, Preliminary Spectrographic Measurements: H. Metcalfe – Some Aspects of the Design of Hypersonic Vehicles; A. J. Eggers, Jr. – Some Considerations of Aircraft Configurations suitable for Long-Range Hypersonic Flight; R. R. Jamison – Hypersonic Air Breathing Engines.

It will be seen from the above titles that this volume is not a text on hypersonic flow but rather a collection of excellent papers that outline some of the recent theoretical and experimental advances in the field. Although the Proceedings will be of far greater value to the research worker, the student should find it a very informative and critical survey of recent developments in research and design concepts in aerophysics and hypersonics.

The reader will get an insight into the performance and interpretation of research results obtained in shock tubes, hypersonic shock tunnels, gun tunnels and arc heated tunnels operating at high temperature and pressure for very short durations. Aeroballistic ranges and conventional hypersonic wind tunnels are also discussed. The above facilities are used in the study of chemical kinetics, heat transfer, skin friction, aerodynamic coefficients, stability and control.

The applied mathematician, the designer of future hypersonic airliners or sub-satellites, and the power plant designer will find several papers to stir their interest. It is extremely difficult for one person to make a critical review. However, with those papers that the reviewer is familiar he has found them to be of excellent quality. The discussions following the papers are very valuable in that they provide some of the constructively critical comments noted above. They also bring some of the topics into sharper focus by pointing out certain advantages, applications, usefulness or drawbacks of a given theoretical, experimental, or design approach. The Proceedings are attractively printed on larger size pages than is usual with generous margins. The figures and photographs are of very good quality and well reproduced. Only a few minor errors and misprints have been noted.

The reviewer is pleased to recommend this volume to the research worker, designer and student of hypersonic flow and aerophysics.

DR. I. I. GLASS

Mechanical Properties of Intermetallic Compounds. Edited by J. H. WESTBROOK. John Wiley & Sons, New York, 1960. 435 pages. Illus. $9.50.

This book is based on a symposium held during the 115th meeting of the Electrochemical Society, May 3-7, 1959 and sponsored by the Electrothermics and Metallurgy Division of the Society. It is said to be the first and only explicit treatment of the mechanical properties of the seventeen papers presented at this symposium.

Some intermetallic compounds are known to possess very attractive high temperature mechanical properties. Others may be potentially interesting because of their semi-conducting properties. For these reasons there has been an increased emphasis on research activities in this field and this book goes a long way in meeting a very timely need for a co-ordinated source of information on this subject.

The editor has succeeded in so arranging the papers that the subject matter is treated in a chronological order. The first chapter is a well organized and comprehensive review of the literature on the subject. The next chapter is an attempt to explain the effect of temperature on strength properties in terms of electronic crystal structure. Following this is a chapter dealing with the extrusion and testing of brittle intermetallic compounds and presenting a general discussion of how the strength of intermetallic compounds varies with temperature. The next three chapters deal with techniques for high temperature tension and torsion testing of brittle bodies, electron microscope fractographic studies aimed at a better understanding of fracture mechanism of NiAl, and Ni_3Al, and a study of the factors affecting the flow process in polycrystalline intermetallics. The following two papers discuss the interaction between dislocations and superlattices; and deformation modes in ordered and disordered face centered cubic intermetallic compounds as illustrated by Ni_3Mn, Pt_3Co, and Cu_3Au. The next paper describes an electron microscope study of the domain structure in the compound AuCu and discusses the observed relationship of dislocations with domain boundaries. Chapter 10 describes an attempt to remove the ordered structure in TiAl by exprosing it to radiation in an atomic pile, in the hope that this treatment would impart some ductility to this compound. While the desired results were not obtained the paper does make a useful contribution to the study of intermetallic compounds. The remaining seven chapters present papers dealing with the mechanical and electrical phenomenology of specific compounds, such as indium antimonide, transition element beryllides, and nickel aluminides, to cite the more important compounds dealt with.

H. V. KINSEY

Organizing the Technical Conference. By HERBERT S. KINDLER. Reinhold Publishing Corp., New York, 1960. 139 pages. Illus. $6.00.

This book is very easy to read. It is well written and well presented and contains a fund of practical advice about every phase of the organization of relatively small, two- or three-day conferences. Its chapter headings give an indication of its scope: Initial Planning, Program Development, Auxiliary, Supporting and Servicing Activities, Promotion and Public Relations, Documentation, The Conference Gathering-Evaluation and Follow-up Action, and a rather detached chapter on The Committee Conference.

The author is Director of the Technical and Educational Services of the Instrument Society of America and might have been expected to give more advice than he does about the convention or ordinary general meeting of a technical society – the meeting which is an annual fixture and which poses the all-important problem of planning a technical programme for it. Such a programme must be attractive and useful to as many members of the society as possible; it must not be too narrow and yet it must avoid at all costs the broad expanse of shallow and overlapping material. It would have been interesting to have Mr. Kindler's advice on this problem, but he says nothing about it in this book. Instead he approaches his subject from the point of view of a group that has something specific to hold a conference about. This gives him a relatively simple situation to make the best of; and he certainly makes the best of it. The book is full of information which can be applied to the organization of conferences of all sorts, from major conventions to fairly small Branch meetings.

And "organization" is just the word. Some 17 committees are provided for in the Organization Chart, together with a group of coordinators and advisory bodies. Hypothetical examples are given to illustrate the work of each, imparting a lively tone to a treatise which could very easily degenerate into a list of "points to watch". Great stress is laid, rightly, on scheduling and four of the chapters contain timetables; those unfamiliar with organizing conferences may be surprised at the lead-times re-

quired for most of the organizational activities. "Allow no less than a twelve-month preparation period between the first planning committee meeting and the start of the conference" is very sound advice. Some shortening of this time is undoubtedly possible if the original concept of the conference programme is fairly simple and if there is some full-time help available to work on the details, but in general, if people would take Mr. Kindler's advice seriously, life would be very much easier for all concerned.

An interesting section at the end of the book deals with the evaluation of the conference, with an Appendix giving a mathematical treatment of Conference Success Rating! Fortunately the latter is intended for use by conferrers rather than organizers. The author cites McGurk's Law – "Any improbable event which would create maximum confusion if it did occur, will occur" – and even a faithful following of all Mr. Kindler's precepts is not likely to prevail. In his despair the organizer must seek a CSR from the conferrer and, if he has followed Mr. Kindler, he may be encouraged by the answer.

H. C. LUTTMAN

FILMS

THE following recently issued films have been brought to the attention of the Institute.

CAI Branches may obtain films from the USA free of duty under Tariff Item 696(1), under a ruling, Reference 4083-246 (JEM) dated the 25th July 1956 from the Department of National Revenue. Copies of this ruling have been sent to the Collectors of Customs and Excise at Toronto, Montreal, Ottawa, Vancouver, Winnipeg, Edmonton, Halifax, Calgary and Quebec City. The local Collector should be consulted when any entry under this ruling is contemplated.

ENGINEERING

(1) The Man, The Machine, The Method

A report on a study conducted by Wright Air Development Division and Lear, Incorporated on a methodology of designing cockpits.

Running time 12 mins, Colour, Sound, 16 mm. Procurable from Railway & Power Engineering Corp. Ltd., P.O. Box 880, Montreal 3, P.Q.

(2) The STOL Otter

A documentary film record of research program conducted jointly by De Havilland Aircraft of Canada and the Canadian Defence Research Board to study problems of stability and control in connection with STOL aircraft. Commencing with the early test rigs constructed during the initial stages, the film follows the progress of the 4-year program, through to the final flight trials of the Otter research vehicle.

Running time 15 mins, Colour, Sound, 16 mm. Procurable from The De Havilland Aircraft of Canada Ltd., Downsview, Ontario.

FLYING

(1) DHC-4 Caribou

A descriptive film dealing with the design and development of the STOL DH-4 Caribou. Sequences depict the various special features, flight characteristics, loading and ground handling capabilities of this aircraft. Demonstrations at the De Havilland Downsview airfield demonstrate the short takeoff and landing performance of the Caribou. US Army scenes show takeoffs and landings from ploughed mud fields, casualty evacuation, airborne paratrooper and supply dropping missions.

Running time 17 mins, Colour, Sound, 16 mm. Procurable from The De Havilland Aircraft of Canada Ltd., Downsview, Ontario.

(2) The X-15

This film shows the months of investigation, study and research necessary before the X-15 could be built and successfully flown.

Running time 27 mins, Colour, Sound, 16 mm. Procurable from North American Aviation, Inc., Dept. 861, International Airport, Los Angeles 45, Calif., USA. (To be insured for $50 when mailed back.)

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SPECIALIST SECTIONS

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At the present time there are three Specialist Sections of the Canadian Aeronautical Institute. To be a member of a Section, it is necessary firstly to be a member of the Institute and secondly to possess certain qualifications peculiar to the Section concerned. These identifying qualifications are set out in the following extracts from Section Regulations.

TEST PILOT SECTION

All members of the Institute who are or have been engaged as pilots in experimental, development, production or maintenance flight testing shall be eligible for membership of this Section.

PROPULSION SECTION

All members of the Institute who are or have been engaged in technical work on propulsion systems shall be eligible for membership of the Section.

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All members of the Institute who are or have been engaged in technical work related to guided flight or space vehicles or who possess technical knowledge of the science and engineering of astronautics shall be eligible for membership of the Section.

Any member of the Institute wishing to be admitted to a Section should apply on a special form which can be obtained from Branch Secretaries or from C.A.I. Headquarters.

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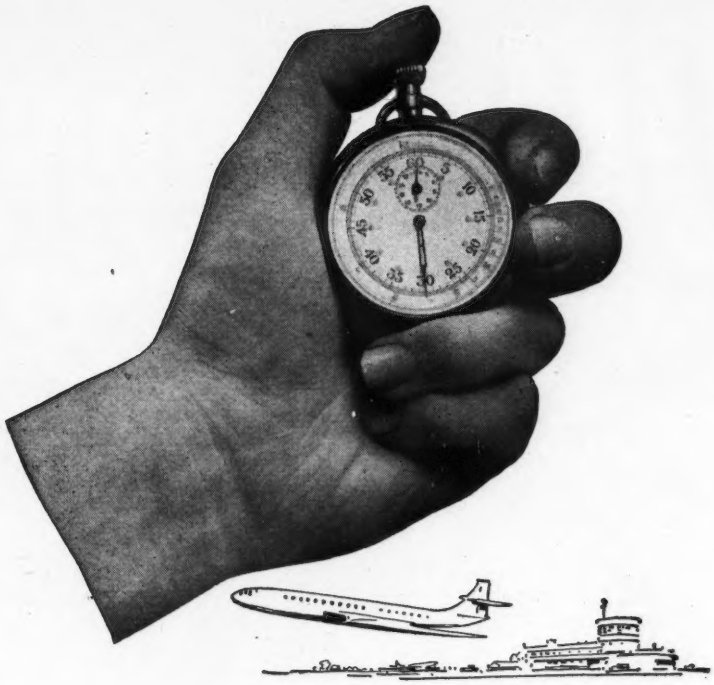

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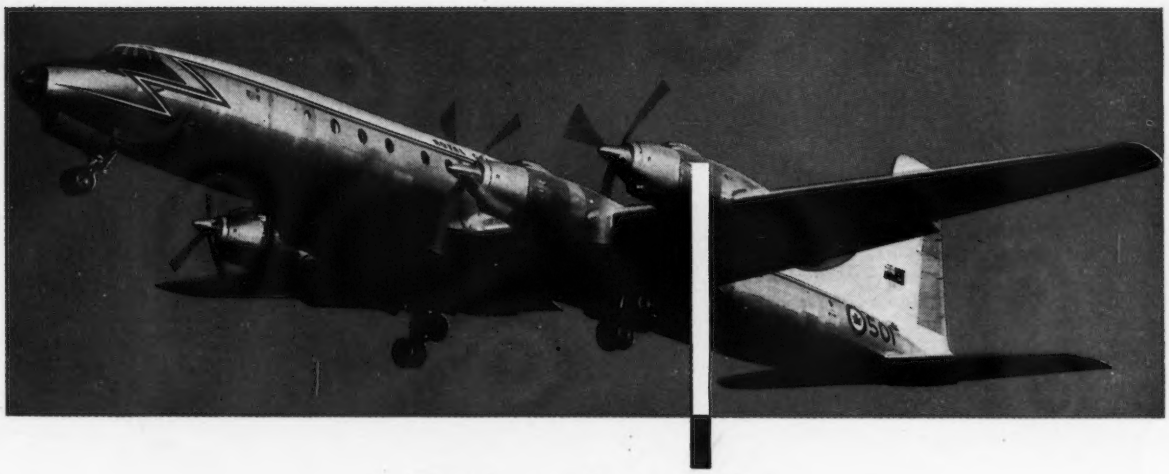
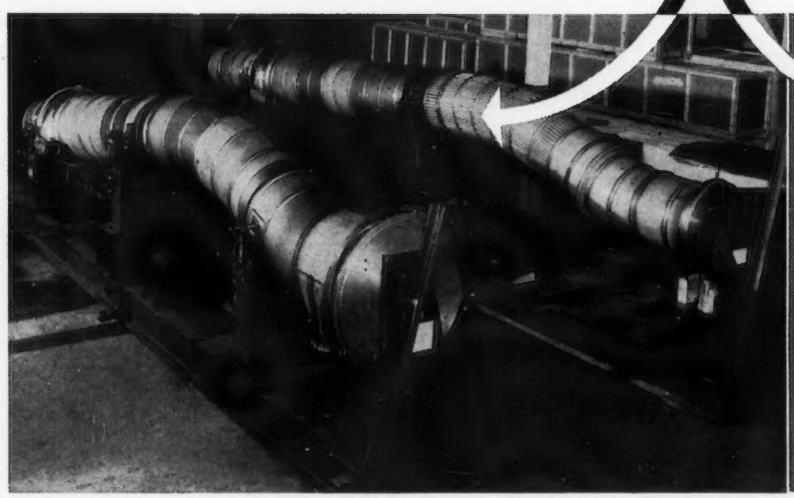
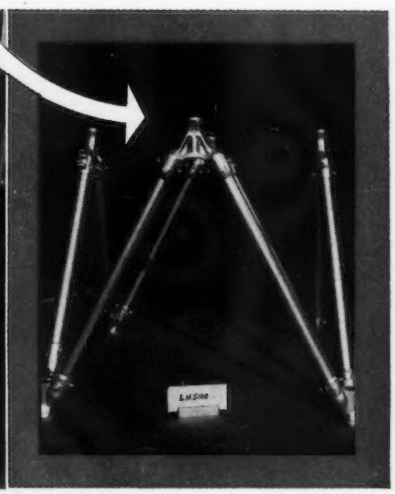


Bristol-made components installed in Canadair's **CL-44**





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